THE AMPHIPOD SUPERFAMILY PHOXOCEPHALOIDEA ON THE PACIFIC COAST OF NORTH AMERICA . FAMILY PHOXOCEPHALIDAE. PART I. METHARPINIINAE, NEW SUBFAMILY.

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ABSTRACT

The amphipod family Phoxocephalidae is represented on the Pacific coast of North America by about 80 species in 35 genera and 7 subfamilies. Metharpiniinae, new subfamily, contains about 45 species in 7 genera, of which 30 species in 5 genera occur in the study region, from Oregon to the Bering Sea, Alaska. In this study, all regional species are described or redescribed, figured, and keyed, and the genera and subfamily are redefined on the basis of new and previously significant character states. The following taxa are new: Metharpiniinae, new subfamily (type genus *Metharpinia* Schellenberg, 1931); *Grandifoxus constantinus,* new species; *G. dixonensis,* new species, *G. pseudonasutus,* new species; *Beringiaphoxus beringianus,* new genus, new species; *Majoxiphalus maximus,* new genus, new species; *Foxiphalus falciformis,* new species; *F. fucaximeus,* new species, *F. slatteryi* new species; ; *Rhepoxynius boreovariatus,* new species; and *R. barnardi,* new species. *Rhepoxynius pallidus* has been elevated to full species status from *R. tridentatus pallidus* (Barnard, 1960).

The subfamily Metharpiniinae is close to, but clearly separable from the primitive Australian subfamily Birubiinae in which its component genera had previously been placed. Phyletic relationships of genera within the subfamily, and of species within genera, are tested by numerical taxonomic methodology. Biogeographically, most species of the Metharpiniinae are North American Pacific, and centred mainly from SE Alaska to southern California. A few primitive species of *Grandifoxus* are isolated along western Pacific shores, and the other species of the subfamily along the North American Atlantic coast, and the Pacific coasts of Central and South America, to the Cape Horn region.

INTRODUCTION

Members of the gammaridean amphipod family Phoxocephalidae are free-living sediment burrowers and micropredators that occur mainly along continental marine coastal shelf regions of the world. Individual species can be extremely abundant, often numbering several hundred or more per square metre of substratum (Slattery, 1985). They serve as important food items for larger invertebrates and fishes, and otherwise as "secondary producers" in marine food energy cycles. Some of the more lab-hardy and easily accessible species are becoming increasingly useful in bioassay assessment of toxic wastes in bottom sediments (e.g. Swartz et al, 1984; Bousfield 1990).

As in most members of the superfamily Phoxocephaloidea and other subfamilies of "Amphipoda Natantia" (Bousfield, in prep), species of family Phoxocephalidae show a primitive reproductive life style whereby mating takes place freely in the water column (Slattery, 1985). There, by means of well-developed eyes, sensory organelles of the antennae, copulatory spines of the hind-most thoracic legs, and powerful pleopods and tail fan, the mature male stage is well adapted for detecting, approaching, and mating with the briefly swimming and newly moulted female (Bousfield, 1979; Barnard & Karaman, 1991). Following copulation, a process yet little understood in this group of amphipods (Conlan, 1992), the presumably non-feeding male soon dies. The female returns to the bottom where she continues to burrow and feed. There during the next several weeks or months, she incubates the fertilized eggs (to hatching stage) in her ventral thoracic brood pouch. As we may note in the following descriptive accounts, character states of such reproductive morphology, especially of the male, are proving to be of fundamental value in the higher classification of these animals.

During the first hundred years of work on amphipod crustaceans of the North American Pacific coast (e.g. Stimpson, 1856; Holmes, 1908; Alderman, 1936; Thorsteinson, 1941, and others) surprisingly little information on free-burrowing species had been developed. The post-WW II arrival on the coasts of Oregon and California of the dynamic J. L. Barnard soon led to the discovery of a rich, almost entirely endemic fauna of phoxocephaloidean burrowers (1954, 1960, etc.). With co-author Margaret Drummond (1978), his extensive revision of the Australian Phoxocephalidae was soon followed by similarly refined and more suitable generic groupings of the N. American Pacific fauna (e.g. Barnard, 1979, 1980; Barnard and Barnard, 1982a, b). These revisions were soon accepted by other N. American workers (e.g. Coyle, 1982). However, Soviet, and to some extent Japanese systematists, working on a less rich northwestern Pacific fauna, partly accepted these changes but continued to coin their own new units (e.g, Gurjanova, 1977,1980a,b) for some of the same higher taxa. Despite the recent comprehensive descriptive updating of world families and genera of gammaridean amphipods provided by Barnard and Karaman (1991), and the sound taxonomic

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basis on which these generic concepts rest, phyletically correct answers to some of these classificatory problems especially at subfamily level, have remained unresolved.

Among the most primitive members of regional phoxocephalids recognized by Barnard (loc. cit.) were members of his new genera *Grandifoxus, Rhepoxynius, Foxiphalus, Metharpinia* Shellenberg, 1931, and extralimitally, *Microphoxus.* The last two genera were relegated to subfamily Birubiinae directly by Barnard and Drummond (1978), and the first three by their inclusion in keys to subfamily Birubiinae of subsequent studies (e. g. in Barnard, 1979; Barnard and Barnard, 1980a,b; Barnard and Karaman, 1991). As is demonstrated elsewhere in this paper (Table I, p. 60), these five genera, plus two other North American endemic genera newly proposed herein, form a new subfamily, Metharpiniinae, of which *Metharpinia* Schellenberg is the type genus.

The present phoxocephalid material, comprising some 30 species in five genera, was accumulated as part of an extensive series of field expeditions conducted during 1955-1980 by one of us (ELB) and colleagues in the coastal marine waters of British Columbia, and the United States of Washington, Oregon, and Alaska. Complete lists of stations and pertinent station data are provided elsewhere (Bousfield, 1958, 1963, 1968; Bousfield and McAllister, 1962; and Bousfield and Jarrett, 1981), and have been summarized also by Jarrett, Hendrycks, and Bousfield, 1989. The present material of Metharpiniinae, and other phoxocephalid subfamilies, amounts to about 3500 specimens in more than 200 station lots. It helps fill the previous distributional hiatus between Alaska and California that, as mentioned by both Barnard (1980a) and Coyle (1982), had handicapped earlier taxonomic and biogeographical conclusions.

The purpose of this study is to describe, illustrate, and classify this remarkably diverse and interesting phoxocephalid amphipod fauna. It also attempts to establish more closely its phyletic and biogeographical relationships with adjacent, previously studied faunas, on both regional and world-wide bases.

SYSTEMATIC SECTION

PHOXOCEPHALIDAE Sars, 1895

Phoxocephalidae Gurjanova, 1951: 361.—Barnard & Drummond, 1978: 39.—Bousfield, 1982: 256.—Barnard and Karaman, 1991: 588.

Type Subfamily. Phoxocephalinae Sars, 1895: 142.

Subfamilies: Joubinellinae Barnard & Drummond, 1978: 152; Tipimeginae Barnard & Drummond, 1978: 46; Parharpiniinae Barnard & Drummond, 1978: 174; Pontharpiniinae Barnard & Drummond, 1978: 40; Birubiinae Barnard & Drummond, 1978: 190; Metharpiininae, new subfamily (Jarrett & Bousfield, 1994, this paper); Harpiniinae Barnard & Drummond, 1978: 528; Leongathinae Barnard & Drummond, 1978: 146; Brolginae Barnard & Drummond, 1978: 87; Phoxocephalinae Barnard & Drummond, 1978: 416; Coxophoxinae Gurjanova, 1977: 68 (new status).

Taxonomic Commentary: The family has been taxonomically diagnosed by Barnard and Drummond (1978) and Barnard & Karaman (1991) and its phyletic classification updated by Bousfield (1982), and Schram (1986). Within superfamily Phoxocephaloidea, the family Phoxocephalidae is very closely allied with the family Urothoidae Bousfield, 1979, especially in morphological features of male reproductive appendages, and burrowing appendages (Bousfield, 1990). As their name implies, phoxocephalids differ mainly in the hooded form of the rostrum, but also in the non-geniculate antennae, the carnivorous mouthparts (reduced molar, strong raker spines, raptorial maxillipedal palp), the specialized form of peraeopod 7, and the distinct downflexed resting position of the urosome.

The subfamilies of Phoxocephalidae proposed by Barnard and Drummond (1978) established a welcome new precedent in the higher classification of gammaridean amphipods. These subfamilies were well conceptualized and remain essentially valid. However, many new genera discovered since that time (see especially Gurjanova, 1977) entrain numerous character states whose taxonomic and phyletic significance was not initially realized. Thus, the family Coxophoxidae proposed by Gurjanova (1977) is based on the unique genus *Coxophoxus.* In all major taxonomic features, this genus is unquestionably a member of the family Phoxocephalidae, whereas its taxonomic differences are more logically recognized at the subfamily level of distinction (above). Similarly, justifiable cases might be made for further subfamily designations within the Joubinellinae (*Matong*) and the Phoxocephalinae *(Limnoporeia)* where basic morphologies are enormously varied. Also, as noted previously, the significance of reproductive and natatory morphology in the male, and burrowing morphology of both sexes, has necessitated extensive subfamily realignment of North American genera and the creation of a new subfamily, the Metharpiniinae, for their more correct phyletic classification.

With respect to subfamily identification within the Phoxocephalidae, comprehensive, multiple-character keys have been provided by Barnard and Karaman (1991), thus obviating any need for such treatment here. However, their allocation of the North Pacific genera of Metharpiniinae, treated therein to the subfamily Birubiinae, requires an updating of that particular key, as follows:

1. Antenna 1, segment 1 variously ensiform (with anteroventral process); uropod ramal apical spines fused or partly embedded; peraeopod 7 (male), copulating spines paired, elongate ..... Metharpiniinae (p. 60)
—Antenna 1, segment 1 never ensiform (lacking anteroventral process);uropod apical spines distinct, large; peraeopod 7 (male) copulating spine single, short,or lacking .. .. Birubiinae

SUBFAMILY SUMMARY

Analysis of nine subfamilies of Phoxocephalidae proposed by Barnard & Drummond (1978) was undertaken in support of comparable subfamily breakout of family Pleustidae (see Bousfield and Hendrycks, 1994). These two groups appear to be morphological-ecological counterparts —two micro-predator groups, one of which lives in sediments, mainly sand (Phoxocephalidae) and the other mainly on hard substrates (Pleustidae). Evolution has proceeded markedly in the mouthparts of the two, in closely comparable ways. Thus, changes in the form of the mandibular molar, utilized by Barnard and Drummond as the basis of subfamily designation in the Phoxocephalidae, are remarkably closely paralleled in the Pleustidae (see Bousfield and Hendrycks, 1994). Therein, the primitive condition is the fully triturative form, but proceeds via a series of reductions of grinding surface, to a small setulose stub, often paralleled by proliferation of molar rim-teeth as cutting tools (Phoxocephalidae), or by modified raker blades, lacinia, and/or incisor (Pleustidae). A 13-character comparison of member genera of subfamilies of Phoxocephalidae is given in Table I. The character states are detailed and ordered in Table II. A summary of subfamily phylogeny, derived by converting the character states into an index of phylogeny, and totalled for each group, gives the ranking in Table I.

TABLE I.

Comparative plesio-apomorphic condition of subfamilies of Phoxocephalidae

Subfamily	Phyletic Index
TIPIMEGINAE Barnard & Drummond	.40
METHARPINIINAE, new subfamily	.45
BIRUBIINAE Barnard & Drummond	.47
JOUBINELLINAE Barnard & Drummond	.51
PONTHARPINIINAE Barnard & Drummond	.53
LEONGATHINAE Barnard & Drummond	.56
PARHARPINIINAE Barnard & Drummond	.58
BROLGINAE Barnard & Drummond	.61
PHOXOCEPHALINAE Sars	.67+
HARPINIINAE Barnard & Drummond	.67

This phyletic order differs in detail from that of Barnard and Drummond (1978). They placed the Pontharpiniinae at the most primitive end and the Joubinellinae in the advanced position, apparently because their concepts of plesiomorphy-apomorphy with respect to gnathopod condition and some other character states were reverse-polarized. The above system tends to agree with phylogenies derived through anlysis of other series of characters and character states and is consistent with analyses in other family groups and with the superfamily analysis developed by ELB (1983). It is especially significant in agreeing with the presence or absence (and location) of calceoli on the antennae of the male, probably the most conservative and fundamental of all characters treated.

METHARPINIINAE, new subfamily

Birubiinae: Barnard & Drummond, 1978: 190 (partim).—Barnard & Barnard, 1982a: 1.—Barnard & Barnard, 1982b: 2.—Barnard & Karaman, 1991: 597 (partim).

Type Genus. *Metharpinia* Schellenberg, 1931: 65.—J. L. Barnard, 1980a: 115.—Barnard & Karaman, 1991: 622.

Genera. *Grandiphoxus* J. L. Barnard, 1979: 374.—Coyle, 1982: 432 (key).—Barnard & Karaman, 1991: 611; *Beringiaphoxus* , new genus (p. 84); *Majoxiphalus,* new genus (p. 86); *Foxiphalus* J L. Barnard, 1979: 372; *Rhepoxinius* J L. Barnard, 1979: 371; *Microphoxus* J L. Barnard, 1960: 291.

Diagnosis: Rostrum laterally incised or fully hooded. Pigmented eyes usually strongly sexually dimorphic. Antennae, peduncular segments heavy, spinose, fossorial. Antenna 1, peduncular segment 2 about equal in length to segment l; accessory flagellum long. Antenna 2, segment 1 variously ensiform. Calceoli (in male) on flagellum of Al, and on peduncle 5 and elongate flagellum of antenna 2.

Upper lip, epistome often produced anteriorly. Lower lip broad, shoulders usually with cones. Mandibular molar, apical surface non-triturative, margins with blade-spines; molar flake lacking; spine row well developed; left lacinia flabellate or irregularly 4-5 dentate; right lacinia bifid, occ. simple or lacking; incisor with weak tendency to 'molarization'; palp, molar hump small or lacking; segment 3 with 1-2 clusters of 'A' setae. Maxilla 1, palp 2-segmented; outer plate ll-spined, outermost often enlarged. Maxilla 2, inner plate the narrower. Maxilliped, inner plate with 1-2 apical spines. Outer plate with inner marginal masticatory spines; palp stout.

Coxae 1-4 relatively short and narrow. Gnathopods 1 & 2, carpus slender, elongate, longer than weakly subchelate propod.

Peraeopods 3 & 4, segment 6 much longer than 5, postero-distal spine elongate, slender; dactyls short. Peraeopods 5 & 6 short, bases and segments 4 & 5 more or less widened; dactyls short. Peraeopod 7, basis small, harpinioid in form; segment 5 (in male) with paired postero-distal copulatory spines; segment 6 often with slight postero-proximal notch.

Pleon 3 plate, hind corner of usually 'rounded' form, face sub-marginally bare of setae. Uropods 1 & 2, rami falcate, weakly spinose behind, apical spines fused or partly fused in ramal tip; peduncle often with stout medial displaced spine. Uropod 3 usually strongly 'parviramus' in female, aequiramous, narrowly lanceolate in male; terminal segment distinct.

Telson lobes long, broad, each usually with two or more apical and one or more (rarely none) dorso-lateral spines.

Coxal gills large, simple, smaller but distinct on peraeopod 7. Brood lamellae narrow, occasionally lacking on peraeopod 5.

TABLE II. COMPARISON OF METHARPINIINAE AND BIRUBIINAE

CHARACTER	CHARACTER STATE	
	Metharpiniinae	**Birubiinae**
1. Al, segment 1	ensiform	simple
2. Uropod apical spines	fused or sunken	free, articulate
3. Peraeopod 7 (male) copulating spines	large, paired	single or absent
4. Mandible, molar	non-triturative no molar flake	weakly triturative molar flake
5. Maxilliped, inner plate	outer plate large	outer plate small
6. Gnathopod propods	slender type, palm vertical	stout type, palm oblique
7. Peraeopods 5 & 6 segments 4 & 5	short, powerful broadened	long, slender often narrow
8. Peraeopod 7, basis	harpinioid, produced behind	narrow, produced downwards
9. Pleon plates 3	rounded, face bare	truncate, face often setose
10. Peraeopod dactyls	short, weak	long, strong
11. U 1 & 2, ramal spines	few, short	many, various
12. Uropod 3 rami	narrow-lanceolate	broad lanceolate
13. Telson spines	dorso-lateral & apical	single, apical only or multiple-apical

Taxonomic commentary. Metharpiniinae is a subfamily name based on the type genus and species *Metharpinia longirostris* Schellenberg, 1931, from the Cape Horn Falklands Island region of South America. The authors agree with the decision of Barnard & Drummond (1978) to exclude *Metharpinia* from their newly erected subfamily Birubiinae, of which the type genus and species is *Birubius panamunus* from SE Australian coastal marine waters. *Metharpinia* as the subfamily type genus, is unfortunately somewhat atypical of most northern hemisphere members of subfamily Metharpiniinae, of which most species are endemic to cool-temperate waters of the Pacific coast of North and South America. Members of the Metharpiniinae are grossly (occ. closely) similar to those of the Birubiinae but are distinguishable by the combination of basic character states in Table II.

Grandifoxus Barnard, 1980

Grandifoxus Barnard, 1980b: 374.—Coyle, 1982: 43.—Barnard & Karaman, 1991: 611.

Type species: *Phoxus grandis* Stimpson, 1856, original designation.

Species. *Grandifoxus acanthinus* Coyle, 1982; *G. aciculahus* Coyle, 1982; *G. Iindbergi* (Gurjanova, 1953); *G.longirostris* (Gurjanova, 1938); *G. constantinus,* new species; *G. dixonensis,* new species; *G. nasutus* (Gurjanova, 1936); *G. pseudonasutus,* new species; *G. robustus* (Guranova, 1938, 1951); *G. vulpinus* Coyle, 1982; *G. westi* (Gurjanova, 1980a).

ARTIFICIAL KEY TO GENERA OF METHARPINIINAE

1. Rostrum distinctly incised, emarginate, or concave in front of eyes (dorsal view) ..... 2.

---Rostrum, outer margin entire, convex, not incised (in dorsal view) ..... 5.

2. Antenna 2, peduncular segment 4 with 3+ anterior marginal clusters of setae; antenna 2, peduncular segment 5 (male) with 4-8 anterior marginal calceoli;uropod 1, peduncular displaced spine lacking (except in the *longirostris* group); maxilliped, inner plate with 2 stout apical spines..... ***Grandifoxus*** (p. 61)

---Antenna 2, peduncle 4 with 1-2 anterior marginal clusters of setae; antenna 2, peduncular segment 5 (male) with 1-2 anterior marginal calceoli; uropod l, peduncular displaced spine usually present, but may be weak; maxilliped, inner plate with single (rarely 2) apical spines ..... .3.

3. Rostrum very short, base narrow (dorsal view); urosome segment 3 with stout dorsal forward-curving hook ..... ***Microphoxus***

----Rostrum normally developed, base broad; urosome 3 smooth above ..... 4.

4. Uropod 1, outer ramus with subapical spines or nails; uropods l & 2, one or more rami spinose to apex; telson with dorso-lateral spines or setae ..... ***.Metharpinia***

---Uropod 1, outer ramus with apical and dorso-lateral spines only; uropods 1 &2, rami with only a few (1-2) mid-posterior spines; telson lacking dorsal lateral spines ..... ***Rhepoxynius*** (p. 107)

5. Peraeopod 5, segments 4 & 5 distinctly wider than deep; uropod 2, outer ramus strongly spinose (4-10+) posteriorly; peraeopod 7, segment 5 distinctly wider than segment 4; maxilliped, inner plate with 2 apical spines; animals large (> 8 mm) ..... 6.

---Peraeopod 5, segments 4 & 5 not wider than deep; uropod 2, peduncle and rami with few (0-3) posterior marginal spines; peraeopod 7, segment 5 little or not wider than segment 4; maxilliped inner plate l-spinose; animals small..... ***Foxiphalus*** (p. 92)

6. Antenna 1 peduncular segment 2 longer than 1; eyes (female) very small; peraeopod 6, segment 4 much longer than wide; telson lobes lacking dorso-lateral spines. ..... ***Majoxiphalus*** (p. 86)

---Antenna 1 peduncular segment 2 shorter than 1; eyes (female) large, conspicuous; peraeopod 6, segment 4 wider than deep; telson lobes with dorso-lateral spines ..... ***.Beringiaphoxus*** (p. 84)

Diagnosis: As defined by Barnard (1980b), (1982a), and Barnard & Karaman (l991)(above). with the following notations: Rostrum constricted. Pigmented eyes present, sexually dimorphic. Antenna 1, peduncle 2 elongate, = > ped. 1; junction of peduncle 3 and flagellum oblique. Antenna 2, peduncular segment 1 weakly ensiform; segment 4, facial spines usually in 2 rows, spines thick, anterior marginal setae in 3-5 clusters; segment 5, facial row of 4-12 spines; in male (known species), with 6-8 calceoli. Mandible, left lacinia 4-5 dentate; right lacinia bifid; molar with 4+ splayed spines; palp segment 3, 'A' setae in 1-2 groups, apex short, oblique. Maxilla 1, inner plate 4-setose. Maxilliped, inner plate with 2-3 apical spines; palp, dactyl elongate, nail small or lacking.

Gnathopods 1 & 2, propod and carpus slender, length 2-3 X depth, palms medium, nearly vertical. Peraeopods 3 & 4, dactyls medium, length 2X width; segment 6 heavily spinose distally. Peraeopod 5, basis medium broad, occasionally narrowest proximally, smaller than basis of peraeopod 6; segment 4 broader than 5; segment 6 not longer than 5. Peraeopod 6 normal, segment 6 not elongate (as in *Majoxiphalus).* Peraeopod 7, basis harpinioid; in male, copulating spines of segment 5 subequal, elong ate, curving forwards, denticulate proximally; segment 6 with postero-proximal notch.

Epimeron 3, hind margin distally long-setose.Urosome 3 smooth above, without tooth. Uropod 1, peduncle with baso-facial setal cluster, displaced spine weakor lacking (except in *longirostris* and *vulpinus* groups) not continuously spinose to apex; inner ramus of uropod with 1 row of marginal spines. Uropod 2, peduncular outer margin strongly spinose. Uropod 3, rami strong, subequal or somewhat unequal, margins setose in female, more strongly so in male. Telson lobes spinose apically and usually dorso-laterally.

TABLE III. METHARPINIINAE: List of described taxa (* Species of present study range)

GENUS AND SPECIES	ECOLOGY	RANGE
Genus *GRANDIFOXUS* J. L. Barnard, 1979		
* *Grandifoxus acanthinus* Coyle, 1982	coastal	Alaska - SE. Alaska
* *Grandifoxus aciculata* Coyle, 1982	coastal	Alaska - BC
* *Grandifoxus constantinus* Coyle, 1982		Bering Sea
* *Grandifoxus grandis* (Stimpson, 1856)	coastal	BC - Central Cal.
* *Grandifoxus lindbergi* (Gurjanova, 1953)	coastal	Aleut - BC
* *Grandifoxus longirostris* (Gurjanova, 1938)	coastal	USSR - Cemtral BC
* *Grandifoxus dixonensis,* new species		Southern BC
* *Grandifoxus nasutus* (Gurjanova, 1936)	coastal	USSR - Aleutians
* *Grandifoxus pseudonasutus,* new species		Aleutians
Grandifoxus robustus (Gurjanova, 1938)		Japan Sea
* *Grandifoxus vulpinus* Coyle, 1982	coastal	Alaska - BC
Grandifoxus westi (Gurjanova, 1980a)		Japan Sea
Genus *BERINGIAPHOXUS,* new genus		
* *Beringiaphoxus beringianus,* new species	coastal	Aleutians
Genus *MAJOXIPHALUS,* new genus		
* *Majoxiphalus major* (Barnard, 1960)	coastal	S. Cal - SE Alaska
* *Majoxiphalus maximus,* new species	coastal	Aleutians - BC
Genus *FOXIPHALUS* J. L. Barnard, 1979		
* *Foxiphalus aleuti* Barnard & Barnard, 1982a	coastal	Alaska
Foxiphalus apache Barnard & Barnard, 1982a		California
Foxiphalus cognatus (Barnard, 1960)		California
* *Foxiphalus falciformis,* new species		BC - Oregon
* *Foxiphalus fucaximeus,* new species		Washington
Foxiphalus golfensis Barnard & Barnard, 1982a		S. California
* *Foxiphalus obtusidens* (Alderman, 1936)		Central. Cal - Oregon
Foxiphalus secasius Barnard & Barnard, 1982a		S. Californ. - Panama
* *Foxiphalus similis* (Barnard, 1960)		California - BC
* *Foxiphalus slatteryi,* new species		Bering
* *Foxiphalus xiximeus* B. & B., 1982		California - BC
Genus *RHEPOXYNIUS* J. L. Barnard, 1979		
* *Rhepoxynius abronius* (Barnard, 1960)	coastal	California - BC
* *Rhepoxynius barnardi,* new species		BC
* *Rhepoxynius bicuspidatus* (Barnard, 1960)		California - S. BC
* *Rhepoxynius boreovariatus,* new species		BC
* *Rhepoxynius daboius* (Barnard, 1960)	coastal	Calif. - Central. BC
Rhepoxynius epistomus (Shoemaker, 1938)		Atl. N. America.
* *Rhepoxynius fatigans* (Barnard, 1960)		California - BC
Rhepoxynius gemmatus (Barnard, 1969)		S. California
Rhepoxynius heterocuspidatus (Barnard, 1960)		S. California
Rhepoxynius homocuspidatus Barnard & Barnard, 1982b		S. California
Rhepoxynius hudsoni Barnard & Barnard, 1982		Atlantic. N. Amer.
Rhepoxynius lucubrans (Barnard, 1960)		Calif. - Central. BC
Rhepoxynius menziesi Barnard & Barnard, 1982a		S. California
* *Rhepoxynius pallidus* (Barnard, 1960)		California - BC
Rhepoxynius stenodes (Barnard, 1960)		S. California
* *Rhepoxynius tridentatus* (Barnard, 1954)		Ore - Cal
* *Rhepoxynius variatus* (Barnard, 1960)		California - BC
**Rhepoxynius vigitegus* (Barnard, 1971)	subtidal	Oregon - BC
Rhepoxynius species 'C, 'D, 'L, B. & B., 1982		S. California

TABLE III. (cont'd)

Genus *MICROPHOXUS* Barnard, 1960		
Microphoxus minimus (Barnard, 1960)		Costa Rica
Microphoxus comutus (Schellenberg, 1931)		Megellanic
Genus *METHARPINIA* Schellenberg, 1931		
Metharpinia coronadoi Barnard, 1980a		Central America
Metharpinia floridana Shoemaker, 1933)		Florida
Metharpinia jonesi Barnard, 1963		California
Metharpinia longirostris Schellenberg, 1931		S. America; Magellanic
Metharpinia oripacifica Barnard, 1980		Central America

The list contains 51 formally described species names, in 7 genera, of which 30 species, in 5 genera, occur in the present study region (Alaska - N. California), distributed as follows: *Grandifoxus (12)* (10*); *Beringiaphoxus* (1) (1*); *Majoxiphalus (2) (2*); Foxiphalus* (11) *(7*); Rhepoxynius (18)* (10*); *Microphoxus (2) (O); Metharpinia (S) (0*).*

Taxonomic commentary. The twelve component species are fairly diverse in body form and size. Four species are large (10 mm+) e.g. *G. grandis, G. lindbergi, G.longirostris, G. robustus,* and the other eight are medium-sized (6-10mm). Cluster analysis reveals five main subgroupings as outlined in the following key to species, viz: *grandis (*unique), *longirostris* gp. *(3); lindbergi* gp.(3, including *robustus* and *westi); acanthinus* gp. (including*vulpinus & aciculus);* and the *nasutus* group.

Grandifoxus grandis (Stimpson, 1856)
(Fig. 1)

Phoxus grandis Stimpson, 1856: 90.—1857: 81-82.
Pontharpinia grandis Stebbing, 1906: 147.
Pontharpinia milleri Thorsteinson, 1941: 82, pl. 5.
Paraphoxus milleri Barnard, 1958: 147.— 1960: 266, pl. 40.
Grandifoxus grandis Barnard, 1979: 374.—1980: 495.—Coyle, 1982: 449, fig. 10 g, h

Material examined.
BRITISH COLUMBIA: Queen Charlotte Islands: ELB & ELM Stns., 1957: H8a (15, including male (8.5 mm), with slide mount; H13 (30); El (5); EI4b (1); E21 (1); WI (5); W2 (5); Wll, Gudal Bay (17, including male (10.0 mm), with slide mount, fig.'d, and 1 male subadult (10.0 mm) CMN Cat. No. NMCC1992-0610. Central Coast: ELB Stns., 1964: HI (10); H7 (4); H13 (30).
Vancouver Island: Northern region, ELB Stns., 1959: N4 (4); N6 (25, including 1 female ov. (lOmm), with slide mount; 017 (1).
Southern region and Strait of Georgia: ELB stns. 1955: P4 (10); P8 (1); P6a (25); Ml (12); Mla (25); M3 (40); M8 (15). ELB Stns, 1964: H40 (2); H41 (1); H45 (25). ELB Stns. 1970: P707 (1 male, subadult (6.0 mm), with slide mount); P708 (2). ELB Stn., 1975: P4a (1 male).

WASHINGTON & OREGON
ELB Stns., 1966: W2 (6); W4 (1); WS (20); W6 (20); W14 (5); W16 (5); W17 (15): Wl9 (3); W24 (25); W39 (1); W40 (2); W41 (10); W45 (20); W46 (16); WSO (3); WSl (l); W52B, Clatsop Spit, Oregon, Aug. 7 (39, including 1 female ov. (10.5 mm) with slide mount, fig.'d) CMN Cat. No. NMCC1992-0611; W53 (1); W59 (1); W61 (10); W62 (8); W63 (30); W64 (10); W66 (2).

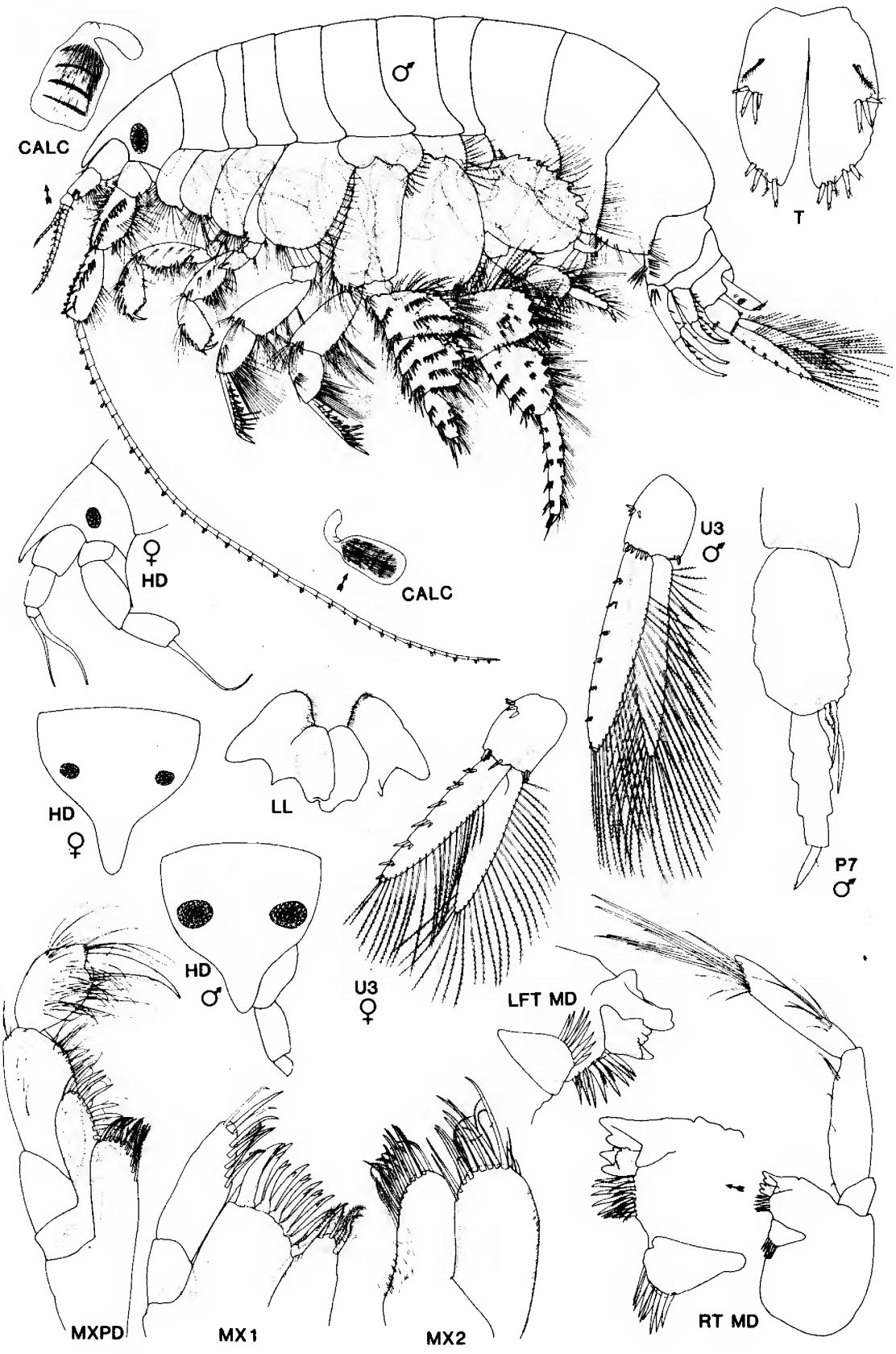
Diagnosis. (Female, 14 mm): Eyes small, oval, weakly pigmented. Rostrum small, basally narrow, tip subacute, barely exceeding peduncular segment 1 of antenna 1. Antenna 1, accessory flagellum long, 12-segmented, nearly equal to 15-segmented flagellum. Antenna 2, peduncular segments 4 and 5 large, broad; segment 4 with nearly continuous facial row of 20+ spines; anterior margin with 6 + groups of spines and/or setae; segment 5 with continuous facial row of about 12 spines.

Mandibular molar prominent, grinding surface weakly

Fig. 1. ***Grandifoxus grandis*** (Stimpson).
MALE (9.5 mm); FEMALE (11.5 mm).
(SEE PAGE 65 - OPPOSITE)

LEGEND FOR FIGURES

Al	- antenna 1	MXPD	- maxilliped
A2	- antenna 2	P3-7	- paraeopods 3-7
CALC	- calceolus (i)	RT	- right
EP1-3	- pleon plates 1-3	U1-3	- uropods 1-3
GNl	- gnathopod 1	UROS	- urosome
GN2	- gnathopod 2	T	- telson
HD	- head	o	- male
LFT	- left	o	- female
LL	- lower lip	MD	- mandible
MXl	- maxilla 1	MX2	- maxilla 2


CALC
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MXPD
MX1
MX2
RT MD

KEY TO SPECIES OF *GRANDIFOXUS*

1. Antenna 2, peduncular segment 4, facial spines numerous (usually 15+) in 2 nearly continous rows, anterior marginal setae in 4+ clusters; peraeopod 6, segment 4 wider than long, wider (but not longer) than segment 5 ..... 2.

----Antenna 2, peduncular segment 4, facial spines less numerous (usually 8-15), in 2-3 distinct subgroup ings; anterior marginal setae in 2-3 median clusters; peraeopod 6, segment 4 distinctly longer than wide, and longer but not wider) than segment 5 ..... .5.

2. Uropod 3, both rami elongate and subequal in females and immatures; gnathopods 1 & 2, carpus and propod slender, length (of each) > twice width; peraeopod 5, segment 6 with 1-3 groups of posterior marginalspines ..... **G. *grandis*** (p. 64)

---Uropod 3, inner ramus distinctly shorter (2/3) than outer in females and immatures; gnathopods 1 & 2, carpus and propod slightly more robust, shorter, length (of each) twice width; peraeopod 5, segment 6 with poster ior marginal setae only ..... 3.

3. Peraeopod 5, segment 4 much wider than long, distinctly wider than segment 5; peraeopods 3 & 4, segment 5, postero-distal spine slender, little wider than adjacent setae; urosome 1 and uropod 1 peduncle, with2-3 clusters of lateral setae; uropod 2, inner ramus marginally bare ..... .**G. *lindbergi*** (p.68)

---Peraeopod 5, segment 4 little wider than long, or width of segment 5; peraeopods 3 & 4, segment 5, postero-distal spine stout, 45 times wider than adjacent setae; urosome 1 & uropod 1 peduncle with 1- 2 lateral setal clusters; uropod 2, inner ramus with posterior marginal spines ....4.

4. Rostrum short, not extending beyond antenna 1, peduncular segment 1; peraeopod 5, segment 4, 4 - 7 spines in each posterior facial row; peraeopod 7, basis, posterior margin with 5-6 weak serrations . ... **G. *westi***

---Rostrum long, extending beyond mid-point of antenna 1, peduncular segment 2; peraeopod 5, segment 4, 8-9+ spines in each posterior facial row; peraeopod 7, basis, posterior margin with 7-8 sharp serrations. ....**G. *robustus***

5. Uropod 3, rami subequal in females and immatures; telson lacking dorso-lateral spines; peraeopods 3 & 4, segment 5, postero-distal spine long, about 3/4 length of segment 6 ..... 6.

---Uropod 3, inner ramus much shorter (<2/3) than outer in females and immatures; telson with 1(2) dorso-lateral spines; peraeopods 3 & 4, segment 5, posterodistal spine normal, 1/2 - 2/3 length of segment ..... 7.

6. Peraeopod 6, segment 6 not longer than segment 5; uropod 1, rami with 1-2 posterio-marginal spines .... **G. *nasutus*** (p. 80)

---Peraeopod 6, segment 6 distinctly longer than 5; uropod 1, rami with 5-6 posterior marginal spines .... **G. *pseudonasutus*** (p. 82)

7. .Antenna 2, peduncular segment 4, facial spines in 3 distinct groups; peraeopod 5, segment 6 slender, length =segment 5, never with posterior marginal spines; uropod 1, peduncle, outer marginal spines short, stout, posterior marginal displaced spine always stout, much stronger than adjacent spines ..... 8.

---Antenna 2, peduncular segment 4, facial spines in 2 distinct groups; peraeopod 5, segment 6 broadest medially, shorter than segment 5; uropod 1, peduncle, outer marginal spines long, slender, posterior marginal displaced spine weak to medium ..... 10.

8. Uropod 2, peduncle with numerous (12+) outer marginal spines; telson lobes each with 2 small dorso-lateral spines ..... ***G. dizonensis*** (p. 70)
---Uropod 2, peduncle with few (1-4) outer marginal spines; telson lobes each with single dorso-lateral spine ..... 9.

9. Uropod 1, peduncle with 1 outer marginal spine; uropod 2, rami with 1-2 marginal spines; telson lobes, apical spines short, subequal ..... ***G. longirostris*** (p. 68)

---Uropod 1, peduncle with 3-4 outer marginal spines; uropod 2, rami with 3- 4 posterior marginal spines; telson lobes, apical spines unequal, one long ..... ***G. constantinus*** (p. 72)

10. Antenna 2, peduncle 5, spines in facial row numerous (10 +); peraeopod 5, segment 6 subovate,posterior margin lacking spine cluster; telson lobes each with 3+ apical spines ... . ***G. acanthinus*** (p. 78)

---Antenna 2, peduncle 5 with 5-6 facial spines; peraeopod 5, segment 6 less broad, hind margin with 1 spine group; telson lobes each with 2 apical spines ..... 11.

11. Peraeopods 5 & 6, dactyls short, length > width of segment 6; uropod 1, displaced spine lacking; uropod 2, inner ramus with 0-1 posterior marginal spines ..... ***G. vulpinus*** (p. 76)

---Peraeopods 5 & 6, dactyl medium, length = width of segment 6; uropod 1, peduncular displaced spine medium stout; uropod 2, inner ramus with 2-3 marginal spines. ..... ***G. aciculatus*** (p. 78)

---

triturating, proximal margin with about 8 blade spines; left lacinia 4-5 dentate, right lacinia flabellate; palp segment 3 with single cluster of outer marginal setae ('A' setae of Cole, 1980); apex obliquely truncate. Maxilliped, outer plate slender; dactyl of palp basally stout.

Coxae 1-2 distinctly smaller than 3, narrow, curved, each with poster-distal marginal tooth, lower margins with widely spread setae; coxa 4 front and hind margins subparallel, lower margin broad. Gnathopods 1-2, carpus and propod slender, shallow, propods not broadened distally, palms small, slightly oblique. Peraeopod 3 & 4 large, segment 4 strongly expanding distally; segment 5 shorter than 6, postero-distal spine slender, long (2/3 strongly spinose segment 6); dactyls medium.

Peraeopod 5, basis broadest distally, hind margin slightly concave; segment 4 much broader than long (deep), with two posterior facial rows of spines (10+ spines in each); segment 5 deeper than 4, broad, with 3-4 posterior facial rows of spines; segment 6 sub-linear, with 2-3 hind marginal groups of spines; dactyl small, thin. Peraeopod 6, basis broadly rounding behind; segment 4 subrectangular, broader than deep; segment 5 narrowing distally, deeper than 4, with 2-3 small medio-facial groups of spines; segment 6 slender, longer than 5, hind margin with 5-6 groups of spines; dactyl small. Peraeopod 7, posterior margin of basis with 8-10 strong teeth or serrations, segment 5 slightly longer than 4.

Pleon plates 2 & 3, hind corners about right-angled. Urosome 1 with postero-ventral and lateral clusters of setae Uropod 1, peduncle with small proximo-lateral cluster of setae, weak outer marginal spines, and no postero-distal displaced spine; rami strongly curved distally, weakly marginally spinose. Uropod 2, outer margin of peduncle with 5-6 medium stout spines; rami strongly curved, weakly posteriorly spinose. Uropod 3, rami long, sub-equal, inner margins strongly plumose-setose, outer margin of outer ramus with 5-6 spine clusters, terminal segment minute.

Telson, lobes broad, each with dorso-lateral cluster of 3-4 medium spines; apices with 3-4 medium spines and single setule. Coxal gills on peraeopods 2 and 3 slender, broader on peraeopods 5-6, short-reniform on peraeopod 7.

Male (12 mm): Eyes medium, oval widely separated. Rostrum shorter and blunter than in female. Antenna 1, flagellum 15-segmented, proximal 10-11 with calceoli; accessory flagellum half its length. Antenna 2, segments 4 & 5 sub-equal in length, anterior margin of 4 with brush setae, of 5 with 7-8 calceoli.

Peraeopod 7, copulatory spines slightly unequal, distally curved forwards, inner proximal margin crenulate.

Uropod 3, slightly larger and more heavily plumose-setose than in female, rami closely sub-equal, terminal segment vestigial.

Telson lobes broad, each with single cluster of 3-4 strong dorso-lateral spines; oblique apices each with 3-4 sub-equal spines.

Distribution and Ecology. Along semi-protected sand beaches, from Dixon Entrance (Queen Charlotte Islands) through British Columbia, south through Washington and Oregon to Pacific Grove, California, often in reduced or brackish salinities, and temperatures reaching more than 20°C. Not yet found in Alaska.

Taxonomic commentary. The species is unique, perhaps justifiably subgenerically distinctive in its many

plesiomorphic character states. Its closest congener is the distributionally non-overlapping north Pacific species, *G. lindbergi.*

Grandifoxus lindbergi (Gurjanova, 1953)
(Fig. 2)

Pontharpinia robusta lindbergi Gurjanova, 1953: 224-225, f. 7,8.—1980: 95.
Grandifoxus sp. R. Barnard, 1980B: 509-513, fig. 2.
Grandifoxus lindbergi Coyle, 1982: 441, figs. 1, 2.

Material examined.
ALASKA: Aleutian Islands: Unimak Island, P. Slattery stns., June-October, 1982, 50 specimens in 9 lots: C1; C18; C62, C66 (including 1 female ov. (12 mm), with slide mount, fig.'d.) CMN Cat. No.NMCC1992-0612; C71, C72, C94 (12, including 1 male, penult. (15.0 mm), with slide mount, fig.'d) CMN Cat. no. NMCC1992-0613; Stn. J1.
St. Paul I., 10 ft. scoop, P. Slattery coll., June 25, 1983: 16 specimens.
Bering Sea, 30 miles W. of Cape Rodney, 80 ft. grab, P. Slattery coll., May 23,1981: 5 specimens.
St. Matthew I., Walrus Cove, 35 ft., P. Slattery collector: 19 specimens.
SE Alaska, Orca Inlet, ELB & DEM Stn. A81, June 19, 1961: 3 specimens.

Diagnosis. (Female ov. to 19 mm). Eyes small, widely separated, weakly pigmented. Rostrum very long, tip subacute, reaching end of peduncular segment 2 of antenna 1. Antenna 1, flagellum about 20-segmented, longer than accessory flagellum. Antenna 2, peduncular segment 4 with about 20 facial spines in nearly continuous row, anterior margin with 6-7 clusters of setae, and a few spines; segment 1 with distinct ensiform process; segment 5 with single facial row of 14-15 spines.

Mandible, molar surface weakly triturative, with 8 distal marginal spines. Left lacinia 4 1/2-dentate; right lacinia unevenly bifid; blade row of about 15 stout blades and accessory plumose setae. Palp segment 3 with 2 clusters of outer marginal 'A' setae; segment 2 with a few outer marginal setae. Maxilliped, inner plate short; dactyl of palp slender, curved.

Coxae 1-3 large, deep, each with small posterior cusp; setae confined to postero-distal corner; coxa 4, margins subparallel. Gnathopods 1 & 2, carpus and propod relatively short and deep; propod distinctly shorter than carpus, length about twice depth.

Peraeopods 3-7, dactyls short. Peraeopods 3 & 4, segment 4 broadening distally; segment 5 short and deep, postero-distal spine slender, short, about half length of strongly spinose segment 6. Peraeopod 5, basis broadest distally, hind margin straight; segment 5 as wide as deep, narrower than 4, with strong anterior and posterior facial spine rows; segment 6 shorter than 5, its slightly bowed posterior margin with clusters of setae only; dactyl short. Peraeopod 6, basis broadly ovate, hind margin nearly straight; segment 4 much broader than deep, with 4-5 posterior facial spine clusters, 2-7 spines per cluster; segment 5 slightly deeper, but less broad, upper posterior facial row with few spines; segment 6 slightly longer than 5, with 4 anterior and 3 posterior marginal spine clusters. Peraeopod 7, basis broad and shallow, hind margin with 5-6 weak teeth; segments 4 & 5 sub-equal in size.

Pleon plates 2 and 3, hind corner slightly obtuse, lower margins convex, heavily setose. Urosome 1 with 2-3 ventro-lateral setal groups. Uropod 1, peduncle with strong baso-facial setal groups, and 3-4 outer marginal spines; rami curved, with 3- 6 marginal spines. Uropod 2, peduncle with 7-8 outer marginal spines, inner ramus smooth. Uropod 3, inner ramus only 2/3 length of outer, both with a few simple inner marginal and apical setae; terminal segment very small.

Telson lobes broad, each with dorso-lateral cluster of 3 short spines, and 2-4 small spines on obliquely truncate apex.

Coxal gills medium, subrectangular, on peraeopods 2-7, medium small and subovate on peraeopod 7.

Male, penultimate stage (14 mm): Pigmented eyes medium, subovate. Antennal calceoli lacking. Antenna 2, flagellum 35-40 segmented. Peraeopod 7, segment 5, copulatory spines not developed. Uropod 3, rami subequal, inner margins plumose-setose, outer margin with 5-6 clusters of spines.

Distribution and Ecology: From Bering Sea and Aleutian Island south through SE Alaska and Central B.C. coast to southern Vancouver Island, in sub-tidal sands to depths of 2.5 metres.

Taxonomic commentary: This largest known species of the genus is usually 12-14 mm., but attains 19 mm in length. Character states are generally less plesiomorphic than in *G. grandis* but less apomorphic than those of the Asiatic Pacific species, *G. robustus* and G. *westi* to which it appears least morphologically remote.

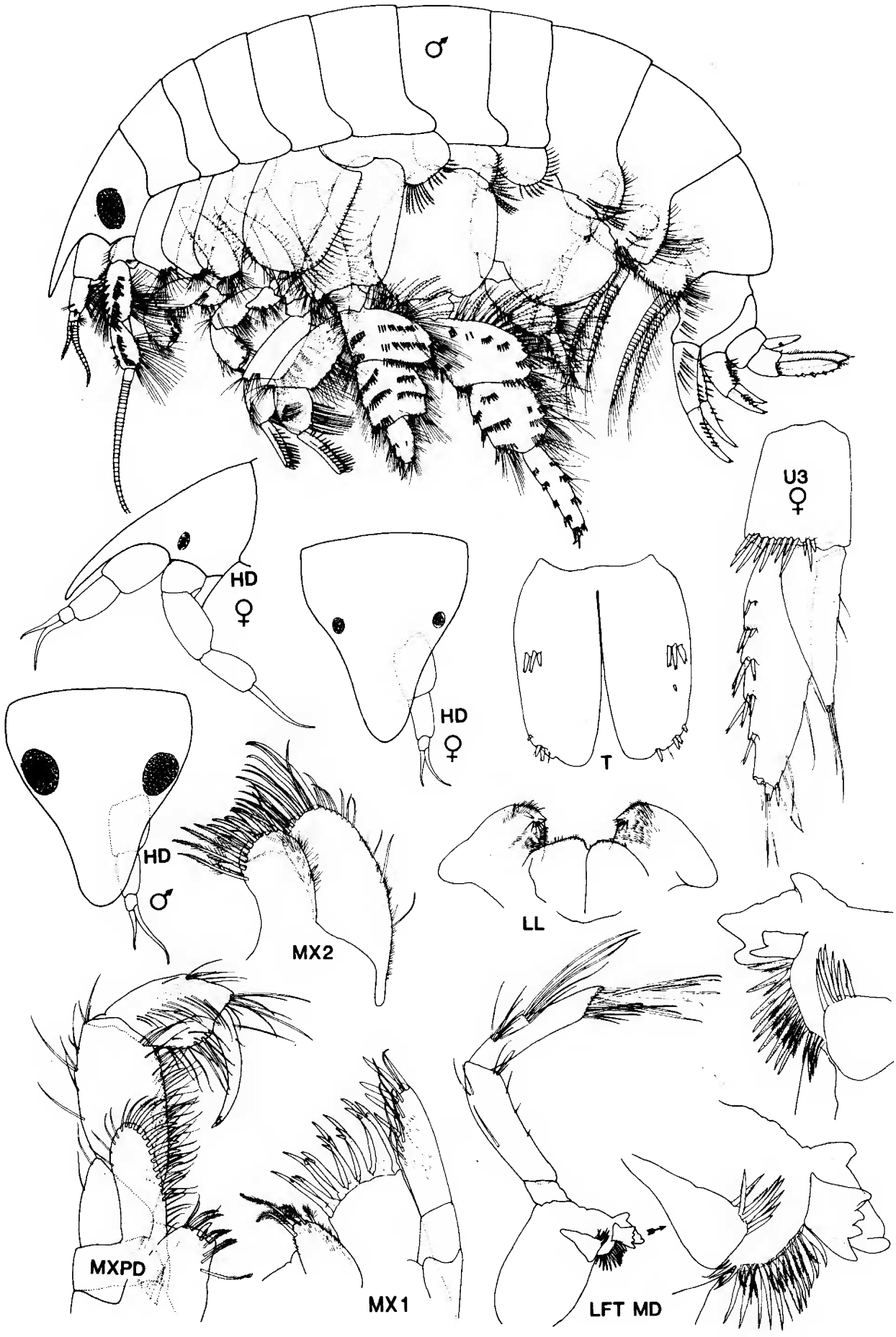
Grandifoxus longirostris (Gurjanova, 1938)
(Fig. 3, male & female; Fig. 4, juvenile?)

Pontharpinia longirostris Gurjanova, 1938: 263, fig. 7.—1951: 385, fig. 235.
Grandifoxus longirostris: Barnard, 1980b: 503, fig. 2.—Coyle, 1982: 447, figs. 8, 9a, b.

Material examined.
ALASKA: Aleutian Islands, Unimak I., P. Slattery coll., June October, 1982: C27 (2 penult males, 3 females); C28 (4

Fig. 2. ***Grandifoxus lindbergi*** (Gurjanova).
FEMALE (12.0 mm); MALE penult (15.0 mm).

(SEE PAGE 69 - OPPOSITE)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penult males, 1 female ov.); C40 (1 broken specimen); C62 (2 females); C68 (3 imm); C76 (1 female br. II, (8.0 mm) with slide mount, head fig'd.) CMN Cat. No. NMCC 1992-0614; C78 (2 inm. females); C79 (2 females, 13 juv.); C80a (1 female, 4 juv.); C80b (2 females, juvs., 1 penult. male); C93 (2 imm. females, 1 penult. male (8.0 mm) with slide mount, fig'd.) CMN Cat. No. NMCC 1992-0615; Clo-ose (2 females; C121 (2 females).
BRITISH COLUMBIA: Central Coast, ELB Stns., 1964: H13, Lelu I. (1 male); H7, McCauley I. - 1 immature (3.5 mm) with slide mount, CMN Cat. No. NMCC1992-0616. Vancouver I., Bonilla I., J. W. Scoggan coll., August 1, 1965 - 1 female.

Diagnosis. (Penult. Male, 8.0 mm): Pigmented eyes large, sub-ovate. Rostrum short, moderately constricted, little longer than basal breadth, apex rounded, barely exceeding peduncle segment of antenna 1. Antenna 1, flagellum short, l0-segmented. Antenna 2, peduncular segment 4, 3 linear facial groups, 6, 5 and 3 spines per group proceeding distally, anterior margin with 2-3 clusters of setae and 2 spines; segment 5 with single facial row of 5 spines.

Mandible, molar process not triturative, distal margin with 8-9 blades; blade row with 2 raker spines; left lacinia irregularly 4-dentate; right lacinia bifid; palp segment 3 with 1 outer marginal cluster of 'A' setae, apex obliquely truncate. Lower lips broad, shoulders of outer lobes cuspate. Maxilliped, inner plate tall; dactyl of palp slender, curved.

Coxae 1-3 large, setae confined to postero-distal angle; coxa 4 distally narrowing, lower margin rounded. Gnathopods 1 & 2, carpus shallow, posterior lobe medium; propod shorter, broadening distally.

Peraeopods 3 & 4, segment 4 moderately expanding distally; segment 5 about as long as segment 6, posterodistal spine about equal to half length of segment 6; dactyls medium. Peraeopod 5, basis margins sub-parallel, nearly straight; segment 4 wider than deep, posterior facial rows with 3 & 6 spines; segment 5 sub-quadrate, deeper than 4, with 1 posterior facial row of 6-7 spines; segment 6 sublinear, shorter than 5, with posterior marginal setae only; dactyl medium, slender. Peraeopod 6, basis medium broad, hind margin almost straight; segment 4 much deeper than broad, with 1 small group of posterior facial spines and a few setae; segment 5 little broadened, shorter than 5; segment 6 longer than 5, with 3 anterior and posterior marginal clusters of spines and a few setae. Peraeopod 7, basis with 6-7 low, weak posterior marginal teeth; segment 5 longer than 4; dactyl slender.

Pleon plate 2, hind margin slightly concave, hind margin sharply rounded; plate 3, hind corner slightly obtuse, lower margin weakly setose. Urosome 1 apparently lacking ventro-lateral setal clusters. Uropod 1, peduncle with 1-2 outer marginal spines, and stout distal displaced spine; rami shallowly curved, each with 2-3 short marginal spines. Uropod 2, peduncle with 5-6 stout outer marginal spines; rami with 1-2 short marginal spines. Uropod 3, rami subequal, margins plumose-setose.

Telson, lobes broad, each with single dorso-lateral spines; apex obliquely truncate with 2-3 short spines.

Coxal gills broad; gill on P7 much smaller than on P6.

Female (br. II, 8.0 mm): Pigmented eyes small. Tip of rostrum blunter than in male. Accessory flagellum about 12-segmented, 3/4 length of main flagellum. Uropod 3, inner ramus 2/3 length of outer ramus; outer ramus, inner margin distally with 4-5 weakly plumose setae; terminal segment distinct.

Distribution and Ecology. From the Bering Sea (Unimak, I.), south to central B. C. and Vancouver I.; in sand, mostly subtidally, from 40-90 m. in depth.

Taxonomic commentary. This material agrees closely with that of Coyle (1982) from the lower Cook Inlet, Gulf of Alaska, but not with that illustrated by Gurjanova (1951) from the Japan Sea. In the latter, the peduncular facial spines are fewer, the inner ramus of uropod 3 (female) is less than half the outer ramus which bears a rather long terminal segment, and each telson lobe apparently bears only a single apical spine. However, as type material was not examined, formal taxonomic separation of the present material was not attempted.

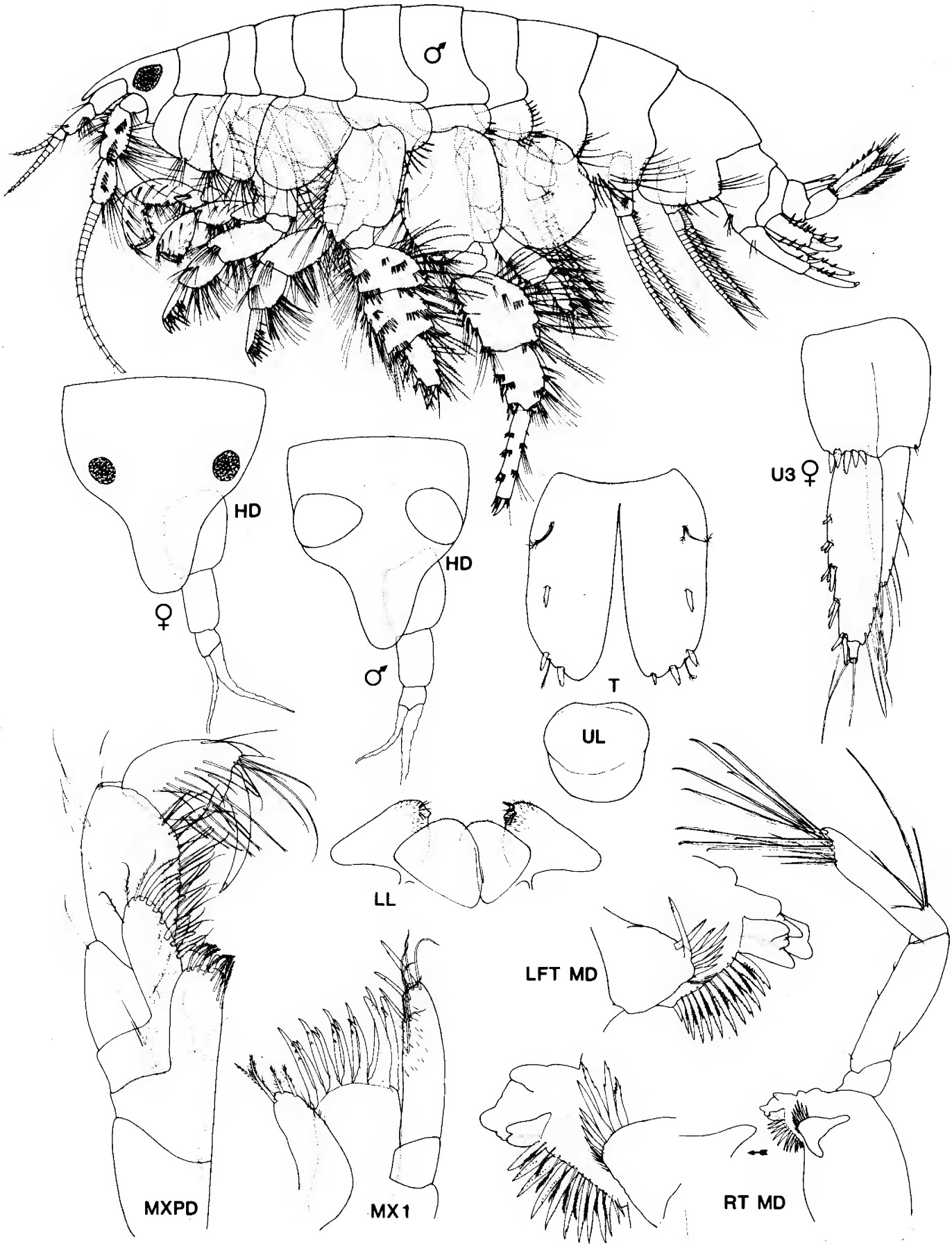
Grandifoxus dixonensis, new species
(Fig. 5)

Material examined.
BRITISH COLUMBIA: Dixon Entrance, inner end, trawl haul, 110 m., fine sand, J. W. Scoggan coll., August 23, 1965: 1 male penult. (8.0 mm) HOLOTYPE, with slide mount, CMN cat. No. NMCC1992-0617; 1 female br. II (6.5 mm) ALLOTYPE, with slide mount, CMN Cat. No. NMCC1992-0618; 2 females, 1 male PARATYPES, CMN Cat. No. NMCC1992-0619.

Diagnosis. (Male, penult. 8.0 mm): Pigmented eyes medium large, sub-rotund. Rostrum large, apex sub-acute, extending well beyond peduncular segment 1, antenna 1. Antenna 1, flagellum short, 10-11-segmented; accessory flagellum 8-segmented. Antenna 2, peduncular segment 4, facial spines in 3 clusters of 6, 6 and 3 proceeding distally, anterior margin with 2-3 setal groups and 1-2 spines; segment 5 with facial cluster of 4 spines. Flagellum 20-segmented, proximal segment apparently conjoint.

Mandible, molar small, with 6 serrated marginal blades; spine row with 10-11 raker blades and accessory setae; left lacinia obscurely 4-dentate; right lacinia weakly bifid (tips

Fig. 3. ***Grandifoxus longirostris*** (Gurjanova). FEM. br II (8.0 mm); MALE penult (8.0 mm)
(SEE PAGE 71 - OPPOSITE)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RT MD

appear worn in the type specimen). Lower lip, shoulders cuspate. Maxilliped ordinary, inner plate medium-tall.

Coxal plates 1-3 large, deep, hind corners rounded, richly setose. Coxa 4 relatively small, distally narrowing, lower margin broadly rounded. Gnathopods 1 & 2 medium slender; carpus of 2 with slightly shortened lower margin; propods slightly broadening distally.

Peraeopods 3 & 4 normally expanded, segments 5 & 6 sub-equal in length, postero-distal spines of segment 5 slender, not exceeding adjacent setae, about 2/3 length of segment 6; dactyls medium. Peraeopod 5, basis medium broad, hind margin straight; segment 4 little broader than deep, with 2 postero-facial groups of spines; segment 5 as broad as, but deeper than, segment 4, with 1 posterior facial group of 8-9 spines; segment 6 sub-linear, hind margin with setae only; dactyl medium strong. Peraeopod 6, basis, hind margin nearly straight; segments 4 & 5 little expanded, segment 4 much deeper than 5, with 5 small postero-facial clusters of spines; segment 6 slightly longer than 5, anterior and posterior margins each with 3 spine clusters; dactyl medium strong. Peraeopod 7, hind margin of basis with 7-8 moderately distinct teeth or serrations; segment 5 longer than 4, slightly shorter than linear segment 6; dactyl medium.

Pleon plates 2 & 3, hind corners sharply rounding, lower margins strongly setose. Urosome 1 lacking ventro-lateral setal clusters. Uropod 1, peduncle with 4 marginal spines and stout distal displaced spine; rami with 3-6 posterior marginal small spines. Uropod 2, peduncle with 7-8 strong outer marginal spines; rami with 3-4 posterior marginal spines. Uropod 3, ramal margins plumose setose, terminal segment distinct.

Telson lobes broad, each with single dorso-lateral spine and 2 unequal spines on obliquely truncate apex.

Coxal gills largest on peraeopods 4 & 5, smallest on P6 and 7.

Female (Br. II., 7.5 mm): Pigmented eyes small, oval. Rostrum slightly broader and longer than in male. Antenna 1, flagellum 1-8 segmented. Uropod 3, inner ramus about half length of outer ramus that is weakly plumose-setose distally on inner margin; terminal segment distinct.

Etymology. Named after the type locality in Dixon Entrance, north of the Queen Charlotte Islands, British Columbia.

Distribution and Ecology. Known only from the type locality; in fine sand, at 110 metres in depth.

Taxonomic commentary. The species is closely allied to *G. longirostris,* but differs in the longer rostrum, more heavily spinose and more strongly dactylate peraeopods, more strongly serrated posterior margin of the basis of peraeopod 7, more heavily setose margins of the pleon side plates, more numerous marginal spines on the uropods, and the unequal apical spines of the telson lobes.

Grandifoxus constantinus, new species
(Fig. 6, male)

Material examined.
ALASKA: Amchitka I., dock at Constantine Harbor, C. E. O'Clair coll., Oct. 5, 1968: 1 mature male (9.0 mm) HOLOTYPE, with slide mount, CMN CAT. No. NMCC1992-0620. Constantine Hbr., P. Slattery coll., Sept. 21,1969:1 male (7.5 mm) broken PARATYPE, with slide mount, CMN CAT. No. NMCC1992-0621.

Diagnosis. (Male, 9.0 mm): Pigmented eyes very large, subquadrate, nearly meeting mid-dorsally. Rostrum medium, apex rounded, extending beyond peduncular segment 1 of antenna 1. Flagellum short, proximal 7 segments bearing calceoli. Antenna 2, peduncular segment 4 with facial spines in 3 groups, each with 3-5 spines; anterior margin with brush setae but no spines; segment 5 with 2 small facial groups of spines, anterior margin with 8 calceoli; flagellum about 40-segmented, calceolate on alternate segments.

Mandible, molar small, margin with 6 blades; spine row with 12 blades; left lacinia evenly 4-dentate; right lacinia bifid; palp segment 3 with one outer marginal cluster of "A" setae, apex obliquely truncate. Lower lip, shoulders with cones. Maxilla 1 inner plate small, with 2-3 apical setae. Maxilliped, inner plate medium tall; palp, dactyl slender, curved.

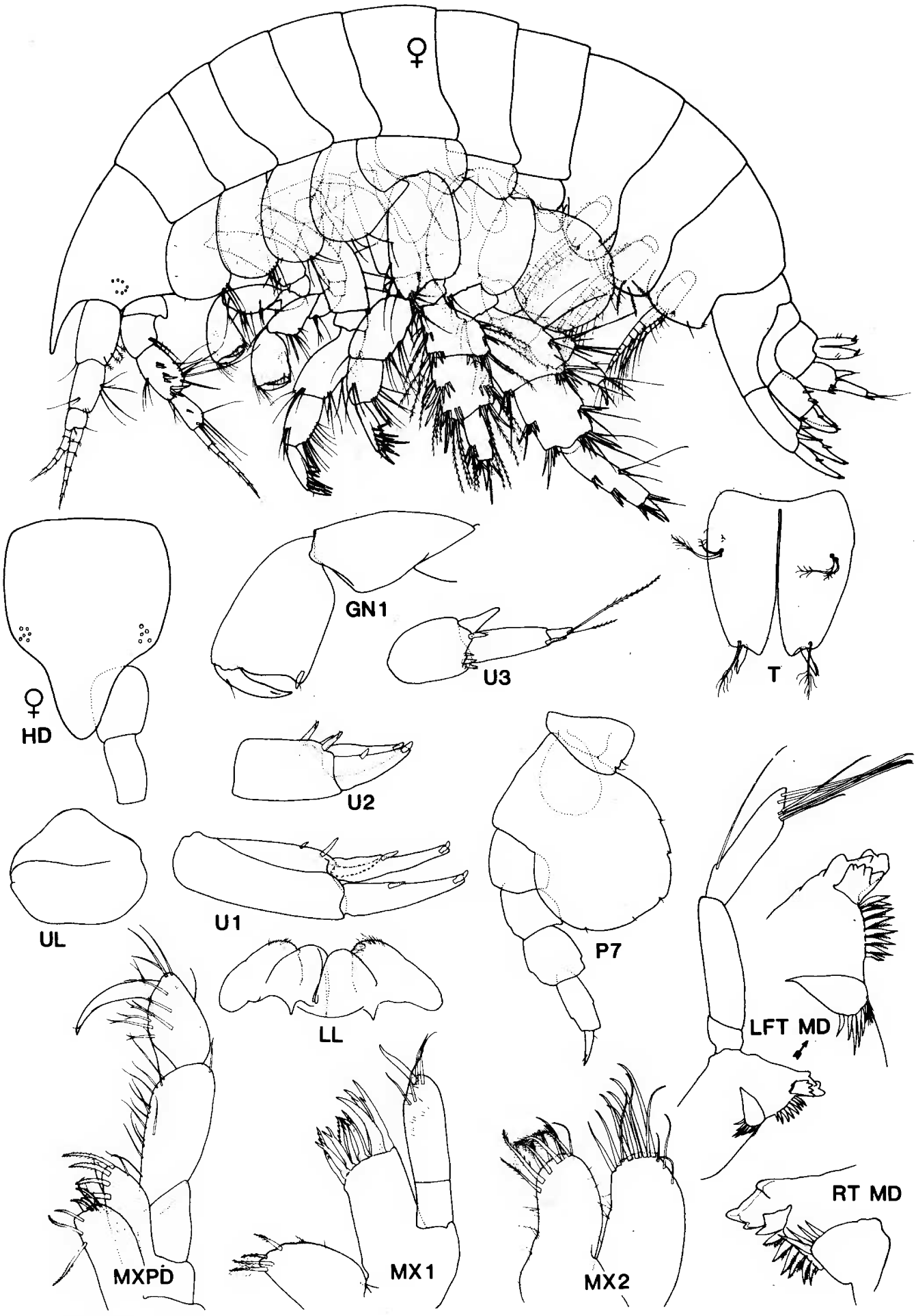
Coxal plates 1-3 large, hind corners strongly setose but not cuspate; coxa 4 strongly narrowing distally, lower margin rounded. Gnathopods 1 & 2 medium, propods slightly broadening distally.

Peraeopods 3 & 4, segment 5 about equal in length to 6, postero-distal spine slender, about 2/3 length of segment 6; dactyls medium. Peraeopod 5, basis regular, hind margin slightly convex; segment 4 slightly wider than deep, with 3 short postero-facial groups of spines; segment 5 deeper than wide, and deeper than segment 4, with 1 short postero-facial row of spines; segment 6 linear, about equal in length to 5, hind margin with setae only; dactyl relatively long, strong. Peraeopod 6, basis little broadened, hind margin gently convex; segment 4 much longer than wide, with 3-4 small groups of postero-facial spines; segment 5 slightly shorter than 4, little expanded, with 1 postero-facial spine group; segment 6 slightly longer than 5, with 3 clusters of anterior and posterior marginal spines and a few setae; dactyl rela-

Fig. 4. ***Grandifoxus longirostris*** Gurjanova imm. (3.5 mm). (SEE PAGE. 73 - OPPOSITE)

Fig. 5. ***Grandifoxus dixonensis*** new species. MALE penult (7.5 mm) HOLOTYPE; FEM.br. II (6.5 mm) ALLOTYPE. (SEE PAGE 74)

Fig. 6. ***Grandifoxus constantinus*** , new species. MALE (9.0 mm) HOLOTYPE. (SEE PAGE 75)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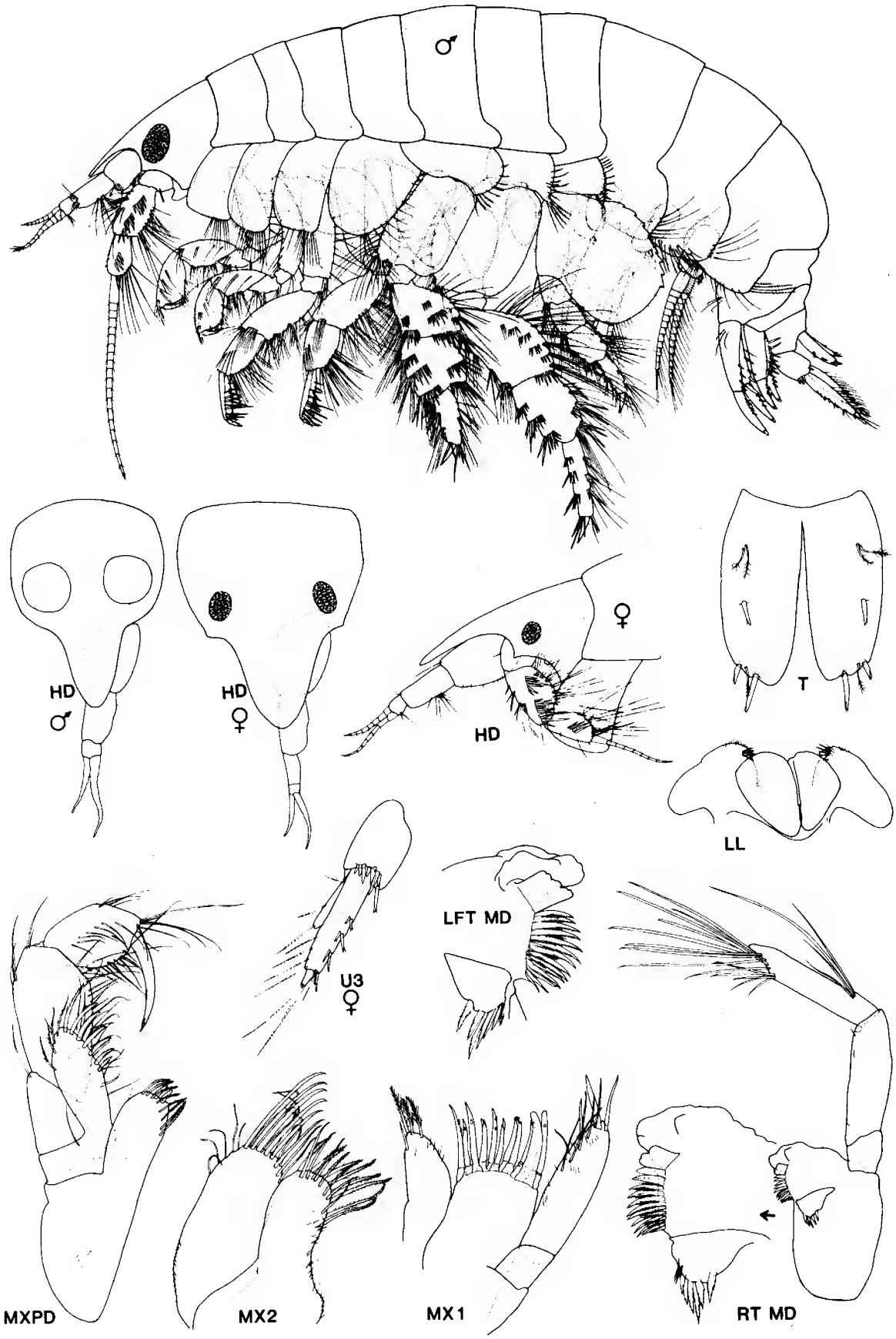
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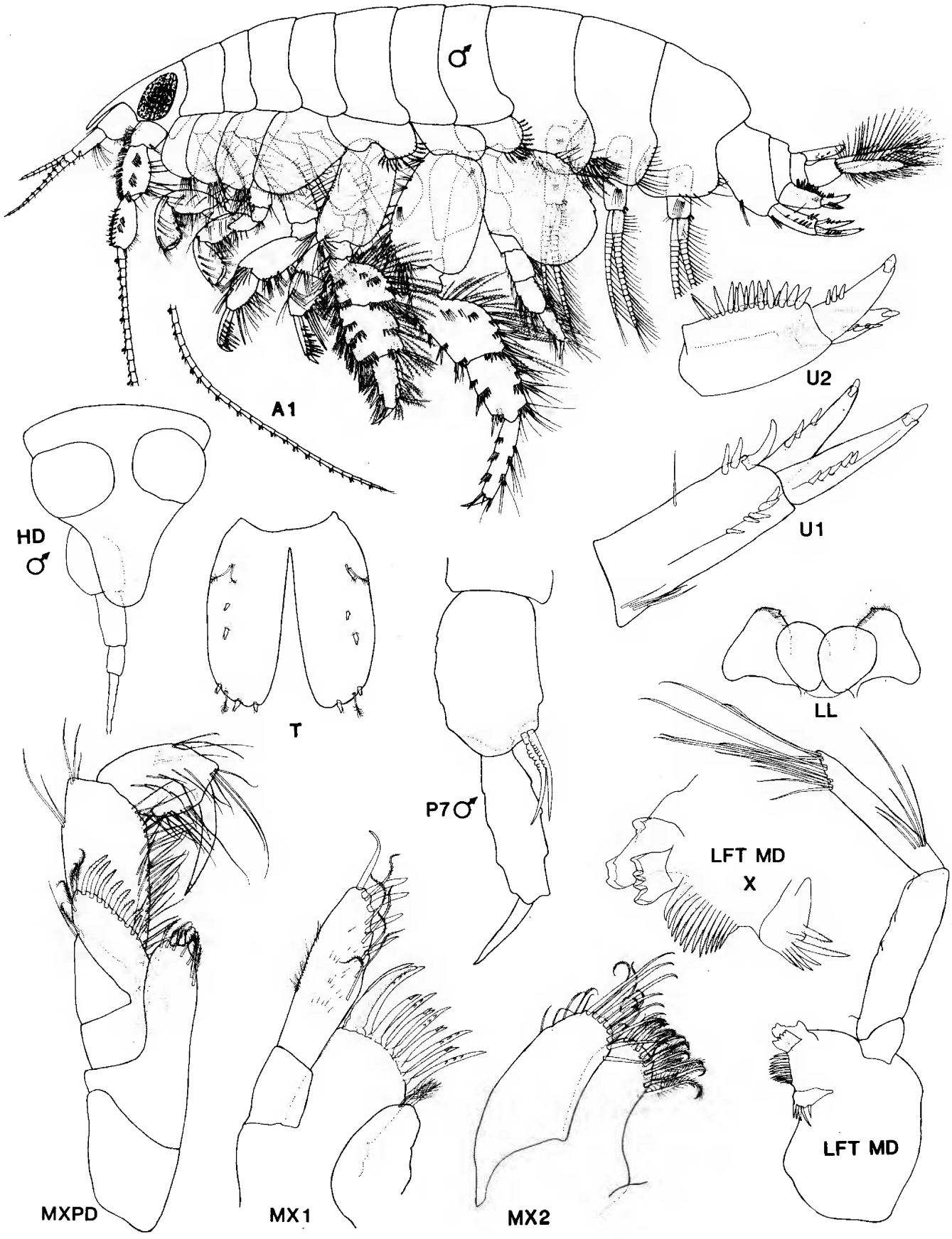
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tively long. Peraeopod 7, basis with 6-8 low posterior marginal teeth; segment 5 distinctly longer than 4, and about equal to 6; paired copulating spines about half the length of segment 6, denticulate proximally.

Urosome 1 lacking ventro-lateral setae. Uropod 1, peduncular outer margin with 4-5 stout spines, displaced spine very large and prominent. Uropod 2, peduncular outer margin with numerous (14+) stout spines; rami 3-4 spinose marginally. Uropod 3, rami strongly plumose setose; terminal segment of outer ramus distinct.

Telson lobes broad, each with 2 small isolated dorso-lateral spines, and 2-3 short spines at oblique apices.

Female unknown.

Etymology. Named after the type locality of the species, Constantine Harbour, Aleutian Islands, Alaska.

Distribution and Ecology. Known only from the Constantine Harbour region of Amchitka, Aleutian Islands, Alaska, in sub-tidal sands near shore.

Taxonomic commentary. Even though known only from a mature male specimen, this species is clearly a member of the *longirostris* group. It differs from the nominate species in the less robust gnathopods, less strongly spinose antennal peduncles, but more strongly spinose uropods.

Grandifoxus vulpinus Coyle, 1982
(Fig. 7)

Grandifoxus vulpinus Coyle, 1982: 444, figs. 5, 6.

Material examined.
ALASKA: Unimak I., P. Slattery coll., June-October, 1982: 64 specimens in 10 lots: C5; C22; C40; C42; C43 (5 specimens, including 1 female ov. (6.0 mm), with slide mount, fig.'d, and 1 male penult (5.5 mm), with slide mount, fig.'d.) CMN Cat. No. NMCC1992-0622; C45; C46; C64; C68; unnumbered station.
St. Matthew I., P. Slattery coll., June 27,1983: 4 specimens.
Bering Sea, 30 miles west of Cape Rodney, 80 ft., P. Slattery coll., May 23,1981: 8 specimens.
Pribiloff Is., St. Paul I., P. Slattery coll., June 25,1983: 7 specimens.

Diagnosis. (Female ov., 6.0 mm): Pigmented eyes small, round. Rostrum short, rounded apex barely exceeding peduncular segment 1 of antenna 1. Antenna 1, flagellum short, 7-segmented, little longer than accessory flagellum. Antenna 2, peduncular segment 4 with two facial groups of 6-8 spines each; anterior margin with 3-4 clusters of setae but no spines; segment 5 with single facial group of 6 spines.

Mandible, molar medium, with 4-9 marginal blades; left lacinia 4-dentate, right bifid; palp segment 3 with single weak cluster of "A" setae. Maxilliped ordinary; outer plate slender.

Coxal plates 1-3 medium broad, hind corners with trace of cusp. Coxa 4 slightly narrowing distally, lower margin rounded. Gnathopods 1 & 2, carpus, slender, shallow, propods deeper, shorter, broadening distally.

Peraeopods 3 & 4, segments 4 & 5 stout, postero-distal spine of segment 5 medium strong, short (much shorter than adjacent setae) tips barely reaching mid-point of segment 6; dactyls medium. Peraeopod 5, basis slightly broadening distally, hind margin gently convex; segment 4 wider than deep, with 3-4 small groups of postero-facial spines; segment 5 as wide as,and slightly deeper than, segment 4; segment 6 short, narrowly ovate, posterior margin with I spine cluster and some setae; dactyl short, slender. Peraeopod 6, basis medium broad, hind margin nearly straight; segments 4, 5, and 6 sub-equal in length; segments 4 & 5 little expanded, 4 with a few small postero-facial spine groups, 5 with 2 postero-facial spines groups; segment 6, margins each with 2-3 spine clusters; dactyl short. Peraeopod 7, basis, hind margin with 6-8 weak marginal teeth; segment 5 slightly broadened, segment 6 slightly longer than 5, dactyl medium.

Pleon plate 2, hind corner rounded, lower margin strongly setose; pleon plate 3, hind corner obtuse, with strong cluster of posterior setae. Urosome 1, lacking ventro-lateral setae. Uropod 1, peduncle with baso-facial cluster of setae, 1-2 distal outer marginal spines, lacking distal displaced spine; rami each with 1-2 posterior marginal spines. Uropod 2, peduncle with 3-4 widely separated outer marginal spines; rami each with 1-2 short posterior marginal spines. Uropod 3, inner ramus slender and very short, less than half the length of the slender, distally plumose setose outer ramus; terminal segment distinct.

Telson lobes, slightly narrowing distally, each with 1-2 medium dorso-lateral spines; oblique apices each with 2 medium spines.

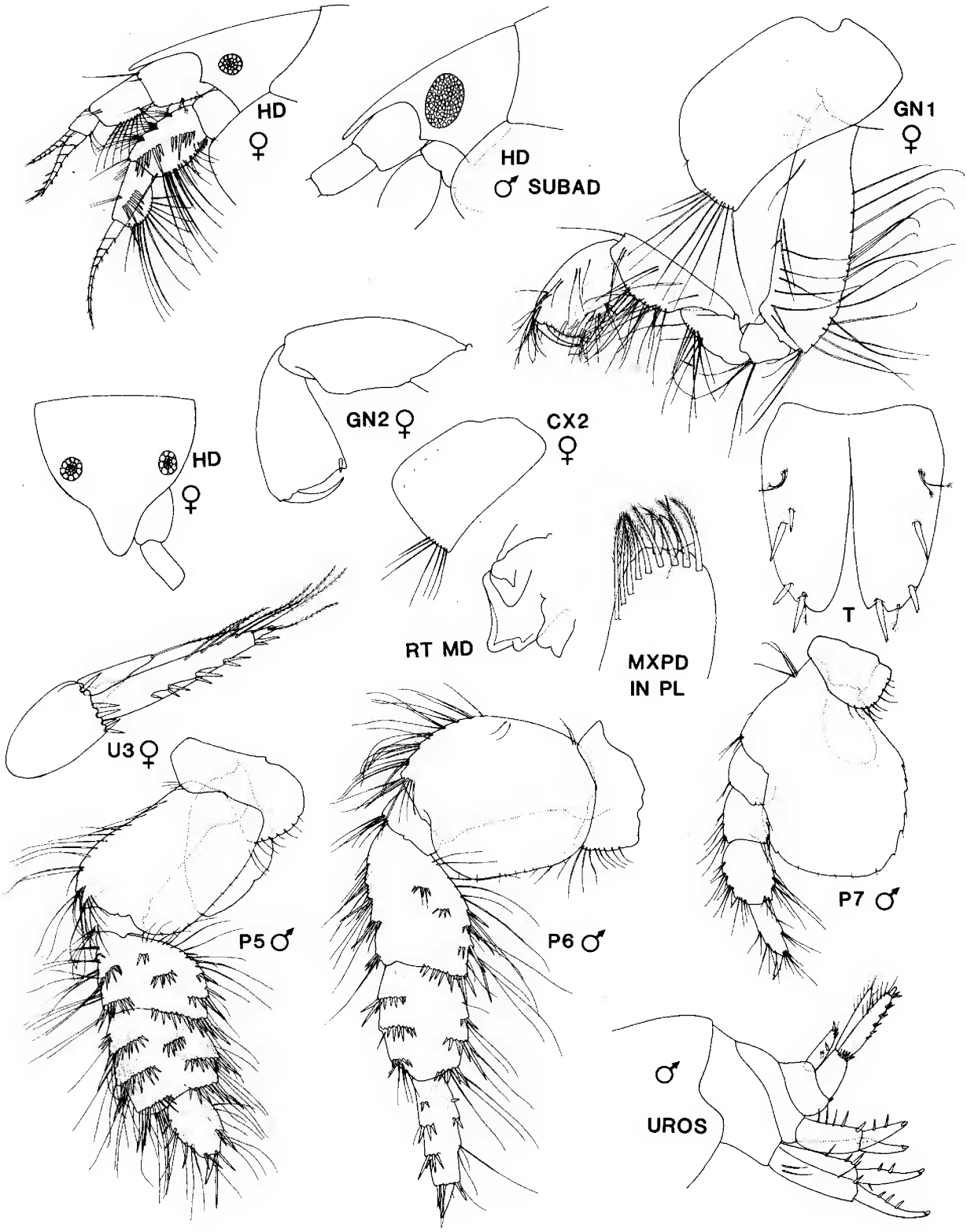
Coxal gills not described.

Male (4.0 mm. penult.): Pigmented eyes medium large, ovate. Antenna 2, flagellum with 18-20 short segments, proximally conjoint. Uropod 3, inner ramus smooth, about 80% length of outer ramus.

Distribution and Ecology. Known only from the central islands, and southeastern part of the Bering Sea to Orca Inlet, subtidally to depths of 87 metres.

Taxonomic commentary. This species is morphologically closest to *G. aciculatus,* and somewhat less so to *G. acanthinus.* In addition to the key characters, it is distinguished by the short rostrum, rounded pleon 2 plate, and sparsely spinose uropods 1 & 2. However, when compared to the Coyle illustrations (1982, fig. 3), the present specimens have slightly more spines on the uropod rami.

Fig. 7. ***Grandifoxus vulpinus*** Coyle.
MALE subadult (5.5 mm)
(SEE PAGE 77 - OPPOSITE)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P5 ♂
P6 ♂
P7 ♂
♂
UROS

Grandifoxus aciculatus Coyle, 1982
(Fig. 8)

Grandifoxus aciculata Coyle, 1982: 448, figs. 9c-g, 10

Material examined.
ALASKA: Aleutian Islands, Unimak Island, P. Slattery coll., June October, 1982: C17 (1 male subad. (6.5 mm), with slide mount, fig'd) CMN Cat. No. NMCC1992-0623; unnumbered station (1 female ov. (7.0 mm), with slide mount); C64 (1 female br. II *(5.5* mm), with slide mount, fig.'d., 9 females, 5 imm. males) CMN Cat. No. NMCC1992-0624. St. Paul I., P. Slattery coll., June 25, 1983; 26 specimens in 2 lots. St. Matthew I., Walrus Cove, P. Slattery coll., June 27,1983: 17 specimens.

Diagnosis. (Female ov., 7.0 mm): Pigmented eyes small, round. Rostrum large, basally broad, sharply rounded apex extending well beyond peduncular segment 1 of antenna 1. Antenna 1, flagellum 8-segmented, little longer than accessory flagellum. Antenna 2, peduncular segment 4, facial spines in two groups of 6 and 9-10 spines; anterior margin with 3-4 clusters of setae but no spines; peduncular segment 5 with single group of 4-5 facial spines; flagellum medium, 11-12 segmented.

Mandible, molar small, with a few small marginal blades; left lacinia 4-dentate; right lacinia bifid; palp segment 3 with single cluster of short "A" setae. Lower lip, shoulders with small cones. Maxilliped ordinary.

Coxal plates 1-3 medium large, increasing posteriorly, hind corners square, cusps very small; setae few (6-8). Coxa 4 narrowing distally, lower margin rounded. Gnathopods 1 & 2, carpus medium deep; propod shortened, broadening distally.

Peraeopods 3 & 4, segment 5, postero-distal spine slender, not longer than adjacent setae, tip reaching nearly 2/3 along segment 6; dactyl medium. Peraeopod 5, basis regular, not widening distally, hind margin very slightly sinuous; segment 4 distinctly broader than deep, with 3-4 medium groups of postero-facial spines; segment 5 slightly less broad but deeper than 4, with two unequal groups of postero-facial spines; segment 6 shorter than 5, medially broadest, posterior margin with setae and one spine group; dactyl long, slender. Peraeopod 6, basis medium, hind margin nearly straight; segments 4 & 5 little broadened; segment 4 slightly longer than 5, with 3-4 small groups of postero-facial spines; segment 6 linear, slightly longer than 5, with 1 group of posterior marginal spines and several setae; dactyl slender, medium. Peraeopod 7, posterior margin of basis with 6-10 weak teeth; segments 3-6 increasingly long; dactyl medium, length less than half that of segment 6.

Pleon plates 2 & 3, hind corners sharply rounding, margins richly setose. Urosome 1 apparently lacking ventrolateral setal clusters. Uropod 1, peduncle with proximoventral seta, 3-4 slender outer marginal spines, and medium strong distal displaced spine; rami long, each with 4-5 strong posterior marginal spines. Uropod 2, peduncle with 1 outer marginal spine; rami with 3 slender posterior marginal spines. Uropod 3, rami virtually devoid of setae, except distally, outer ramus about twice length of inner; terminal segment distinct.

Telson lobes broad, outer margins bowed, each lobe with single dorso-lateral spine, and two medium-length apical spines. Coxal gills not described.

Male (antepenult, 6.5 mm): Pigmented eyes only slightly large than in female. Antenna 2, flagellum with about 20 short segments proximally conjoint. Uropod 3, inner ramus distinctly the shorter inner margin of outer ramus plumose-setose. Urosome 3 with small ventro-distal cluster of spines, at base of uropod 3.

Distribution and Ecology. Unimak, St. Paul, St. Mathew Islands and southeastern Bering Sea, Orca Inlet, south to Saanich Inlet, B. C., sub-tidally to depths of nearly 100 metres.

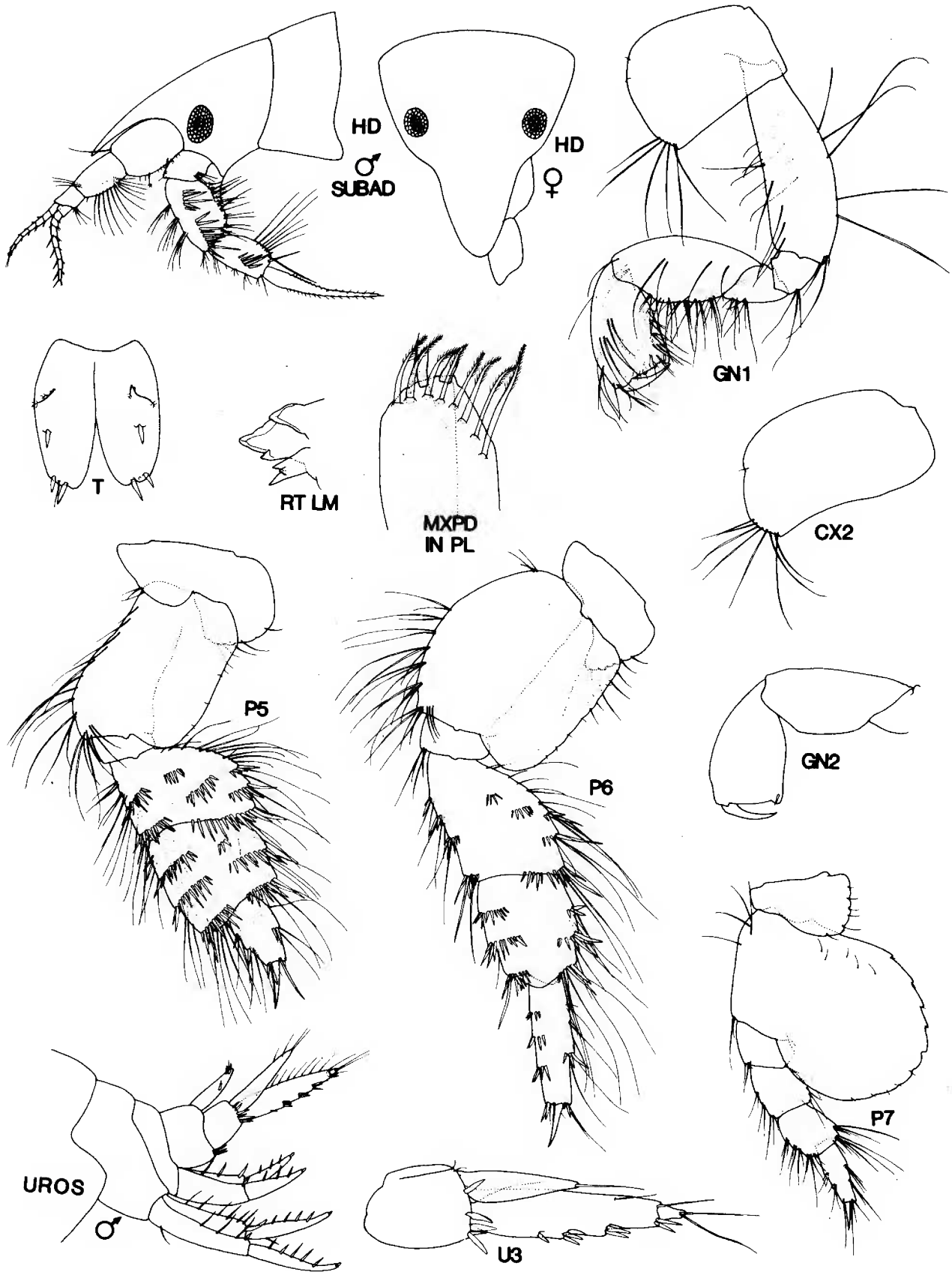
Taxonomic commentary. This species shows many similarities to *G. vulpinus* but is slightly more distant to *G. acanthinus*. *G. aciculatus* differs not only in the characters of the key (p.) but in its larger, broader rostrum; broader more rounded anterior coxal plates; stronger dactyl of peraeopod 5; but weaker group of postero-distal (pre-peduncular) spines on urosome 3.

Grandifoxus acanthinus Coyle, 1982
(Fig. 9)

Grandifoxus acanthinus Coyle, 1982: 444, figs. 5, 6.

Material examined.
ALASKA: Aleutian Islands, Unimak Island. P. slattery colln., June-October, 1982: 50 specimens in 11 lots, including female imm. (4.5 mm), with slide mount.
Bering Sea, NE of St. Lawrence I., P. Slattery colln., July 10,1980:13 immature specimens, including 1 male subad. (5.0 mm) with slide mount, fig'd. CMN Cat. No. NMCC1992-0625.
Along shore 25, 26, and 40 miles S. of Nome, P. Slattery colln., May and June, 1981: 20 specimens in 3 lots.
SE Alaska, ELB & DEM stns., 1961: A32, Holkam Fay (35 subadult males and females); Al 40, MacLeod Bay (13 specimens, mostly immature, including 1 female ov. (6.0 mm), with slide mount, fig'd.). CMN Cat. No. NMCC1992-0626.

Fig. 8. ***Grandifoxus aciculatus*** Coyle.
FEM. br. I (5.5 mm); MALE subad. (6.5 mm).
(SEE PAGE. 79 - OPPOSITE)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SUBAD
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GN2
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Diagnosis. (Female 6.0 mm): Pigmented eyes medium, oval. Rostrum medium strong, basis medium broad, subacute apex extending to middle of segment 2 of antenna 1. Antenna 1, flagellum short, with 9-10 segments, longer than 7-segmented accessory flagellum. Antenna 2, peduncular segment 4, facial spines in 2 linear clusters of 6-8 spines each, anterior margin with 3-4 clusters of seta but no spines; segment 5 with weakly divided row of 5-6 facial spines; flagellum ll-segmented.

Mandible, molar small, with 4-6 short blades; spine row with 8-10 short blades; left lacinia 4-dentate; right lacinia bifid; palp segment 3, outer margin with cluster of short "A" setae. Lower lip with weak shoulder cusps. Maxilliped, inner plate short; outer plate straight, with 10 inner marginal blade spines; palp segment 2 strong, broad.

Coxa 1-3 large, rectangular, hind corners squarish, lacking cusps. Coxa 4 slightly broader than 3, slightly narrowing distally, lower margin slightly indented. Gnathopods 1 & 2, carpus relatively short and deep, propod slightly shorter, distally broadest, palms vertical.

Peraeopods 3 & 4, segment 5, distal spine medium strong, not exceeding adjacent setae. Peraeopod 5, basis broad, margins sub-parallel, hind margin nearly straight; segment 4 much broader than deep, with 5 variably sized postero-facial groups (rows) of spines; segment 5 less wide but deeper than 4, with single postero-facial row of spines; segment 6 very short and relatively broad, hind margin setose but lacking spines; dactyl slender, medium. Peraeopod 6, basis broad, hind margin nearly straight; segments 4 & 5 little expanded; segment 4 longer than 5, with 4-5 small groups of poster-facial spines; segment 5 deeper than wide, with 2 weak postero-facial spine clusters; segment 6 little longer than 5, margins each with 3 spine clusters; dactyl short. Peraeopod 7, basis, hind margin with 8-10 weak serrations; segment 5 larger than 4; segment 6 longest; dactyl short.

Pleon plates 2 & 3, hind corner rounded, posterior and lower margins strongly setose. Urosome 1 lacking ventro-lateral setal clusters. Urosome 3 with strong postero-ventral fan of spines at base of peduncle of uropod 3. Uropod 1, peduncle with baso-facial fan of setae, with 6-8 tall, slender outer marginal spines, but lacking distal displaced spine; outer ramus with 6-7 slender posterior marginal spines, inner ramus with a single proximal medial spine and 2 posterior marginal spines. Uropod 2, peduncle with 5-8 slender outer marginal spines; rami each with 3-5 posterior marginal spines. Uropod 3, inner ramus more than half length of outer, inner margin weakly setose; outer ramus, inner margin strongly plumose-setose, outer margin with numerous spine clusters; terminal segment small.

Telson lobes slightly narrowing distally, each with single dorso-lateral spine and 3-5 slender apical spines. Gills undescribed.

Male (subadult, 5.5 mm): Pigmented eyes medium, lateral. Rostrum strong, similar to that of female. Uropod 3, rami sub-equal, inner margins plumose-setose.

Male (mature, 8.0 mm, from Coyle, 1982): Calceoli on proximal 6-8 flagellar segments of antenna 1; 7 calceoli on anterior margin of peduncular segment 2 of antenna 2, and on alternate segments of 40-segmented flagellum. Copulatory spines of segment 5 of peraeopod 7 strongly denticulate proximally.

Distribution and Ecology. Eastern Bering Sea, and Unimak I., also coastal regions from south of Nome to Prince William Sound and Holkam Bay. In varying types of sand, subtidally to 87 m. in depth.

Taxonomic commentary. The present specimens differ slightly from those described and figured by Coyle (1982) in having spines (as well as setae) on the anterior margin of segment 6 of peraeopod 5, but having less spinose peduncular segments of antenna 2, and uropods 1 & 2, and in their generally slightly smaller size.

Grandifoxus nasutus (Gurjanova, 1936)
(Fig. 10)

Pontharpinia nasuta Gurjanova, 1936: 249, fig. 3.—1951: 382, fig. 3.—1951, p. 383, fig. 232.
Pontharpinia nasuta: Gurjanova, 1980a: 95.
Grandifoxus nasuta Coyle, 1982: 446, fig. 7.

Material examined.
ALASKA: Bering Sea, St. Lawrence I., P. Slattery coll., July 10, 1980: 2 interbrood females (6.5 mm fig'd., 6.75 mm), with slide mounts, 7 females, 1 subadult male (5.5 mm) with slide mount, fig.'d. CMN Cat. No. NMCC1992-0627.
Amchitka I., dock at Constantine Harbor, C. E. O'Clair donor, October 5,1968: 1 male.

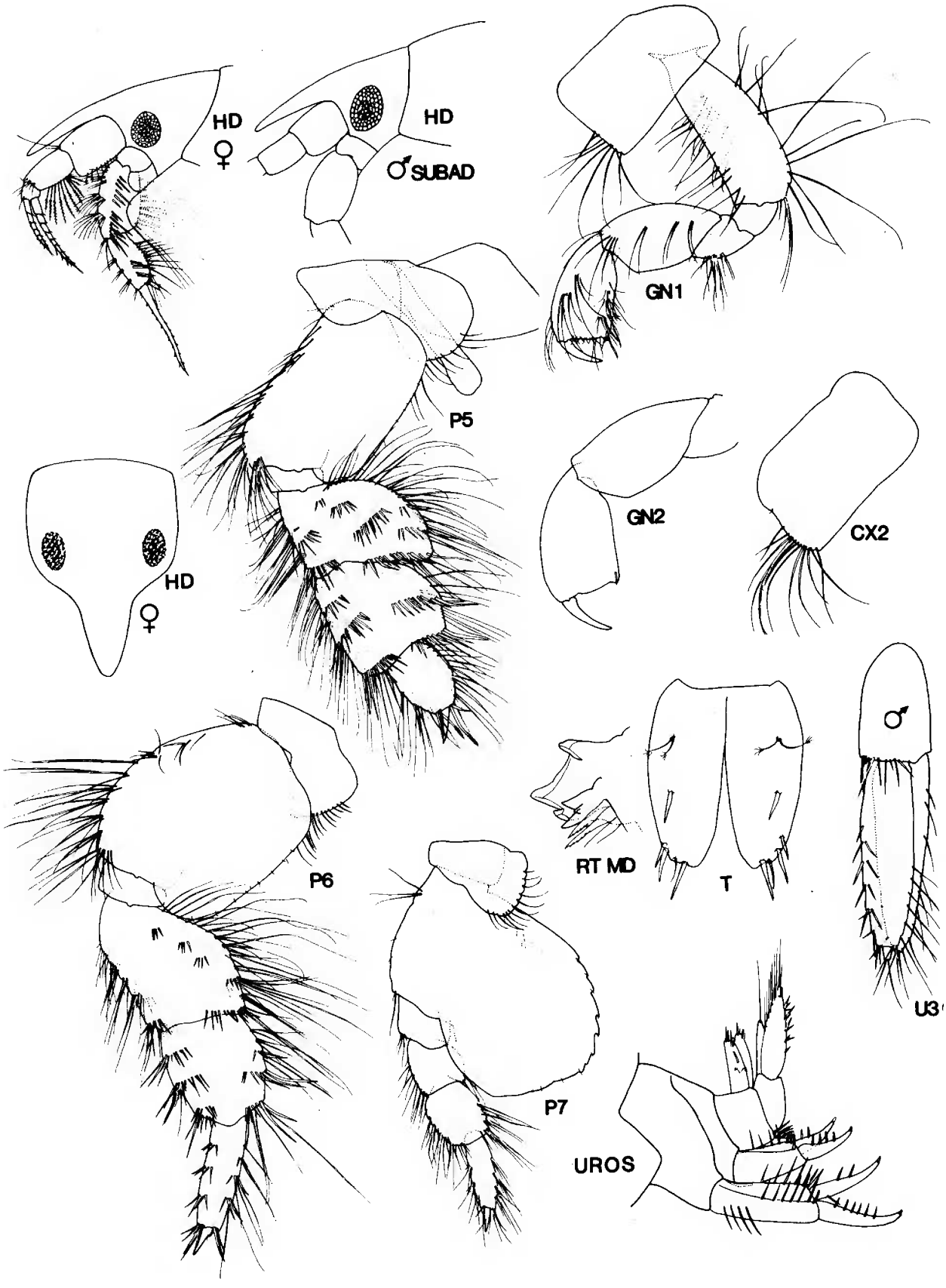
Diagnosis. Female, br. II (6.75 mm): Pigmented eyes very small, oval. Rostrum medium, broad at base, apex acute, extending well beyond peduncular segment 1 of antenna 1. Antenna 1, flagellum short, 7-8 segmented. Antenna 2, peduncular segment 4 with 3 groups of facial spines, 4-5 spines per cluster; anterior margin with 3-4 clusters of setae, but no spines; segment 5 with single facial cluster of 6 spines; flagellum 7-8 segmented.

Mandible, molar weak, with 8 margin blades; spine row short, with 10-11 blades; left lacinia unevenly 4-dentate; right lacinia bifid; palp segment 3 with weak outer marginal cluster of "A" setae, apex sharply and obliquely truncate. Maxilla 1, apex of palp with 4-5 spines. Maxilliped ordinary.

Coxal plates 1-3 large, deep, hind corners rounded, long-setose. Coxa 1 plate 4 very broad, narrowing distally, rounded below. Gnathopods 1 & 2, carpus relatively short and deep, propods relatively short, broadening distally.

Fig. 9. ***Grandifoxus acanthinus*** Coyle.
FEMALE ov. 6.0 mm); MALE (5.0. mm).

(SEE PAGE 81 - OPPOSITE)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Peraeopods 3 & 4, segments 5 & 6 subequal; postero-distal spine of segment 5 long, slender, exceeding adjacent setae, and extending about 3/4 length of segment 6; dactyls short. Peraeopod 5, basis large, hind margin gently convex; segment 4 slightly wider than deep; with 2 small postero-facial groups of spines; segment 5 slightly narrower, but deeper than 4, with one postero-facial row of spines; segment 6 sublinear, hind margin with setae only; dactyl slender, but stouter than in P6 & 7. Peraeopod 6, basis medium broad, hind margin straight; segments 4 & 5 little expanded; segment 4 much deeper than 5, with 3-4 small facial clusters of spines near posterior margin; segments 5 & 6 subequal in length, 6 short, with 2 anterior and 1 posterior clusters of spines; dactyl spender. Peraeopod 7, basis broadly rounding, hind margin with 10-12 low teeth or serrations, distally indistinct; segments increasing slightly in length distally.

Pleon plate 2 broadly rounded behind, lower margin strongly setose; pleon plate 3, hind corner obtuse, lower margin with 5-6 setae. Urosome 1 with small cluster of postero-ventral setae. Uropod 1, peduncular outer margin almost bare, displaced spine small or lacking, not larger than adjacent spine; rami with 1-2 posterior marginal spines. Uropod 2, peduncular outer margin distally with 2-3 stout spines, and proximally with 3 slender spines; rami with 1-2 postero-marginal spines. Uropod 3, inner ramus slightly the shorter, inner margins of both with 5-7 plumose setae; terminal segment small but distinct.

Telson lobes broad, lacking dorso-lateral spines, their obliquely rounding apices each with 3 unequal spines.

Coxal gills not described.

Male (antipenult. 5.25 mm): Pigmented eyes relatively small, lateral, ovate. Rostrum slightly broader and more rounded apically than in female. Antenna 2, flagellum with about 15 short segments. Uropod 3, rami subequal; relative to the female the rami are broader, and spines of the outer ramus are shorter.

Distribution and Ecology. Bering Sea, island and coastal continental regions; subtidal sands, to more than 50 m. depth.

Taxonomic commentary. This material is very close to that described from this general region as G. *nasuta* by Coyle (1982). In the mature male specimen (7.5 mm) from the Bering and Chukchi Seas, figured by Gurjanova (1951), antenna 2 is short, with only 19 flagellar segments, alternately calceolate; peduncular segment 5 bears 5 anterior marginal calceoli. Noteworthy in her peraeopod 7 is the pair of very long slender forward-curving copulating spines that extend beyond the distal margin of segment 6.

In balance of apomorphic character states, this species appears to be the most advanced of all species of *Grandifoxus* known to date.

Grandifoxus pseudonasutus, new species
(Fig. 11)

Material examined.
ALASKA: Amchitka I., Constantine Harbor, P. Slattery coll., Sept. 21, 1969: 1 male (6.5 mm) HOLOTYPE with slide mount, CMN Cat. No. NMCC1992-0628.

Diagnosis. (Male 6.5 mm): Eyes large nearly meeting mid-dorsally. Rostrum large, rounded apex reaching mid-point of peduncular segment 1 of antenna 1. Antenna 1, flagellum 10-segmented, proximately calceolate. Antenna 2, peduncular segment 1 with ensiform process; segment 4 relatively short, with 3 groups of facial spines, 3-5 per group, anterior margin with strong brush setae; segment 5 with 5 relatively large calceoli, anterior margin with 7-8 clusters of brush setae; flagellum about 26-segmented, alternately calceolate.

Mandible, molar small, right molar with 6-8 blades, left molar with 4 blades; spines row with 10-11 blades; left lacinia 4-dentate, right lacinia bifid; palp with weak cluster of "A" setae apex obliquely truncate. Maxilla 1, palp with 3 apical spines. Maxilliped ordinary, outer plate relatively narrow and short. Lower lip, shoulders with prominent cones.

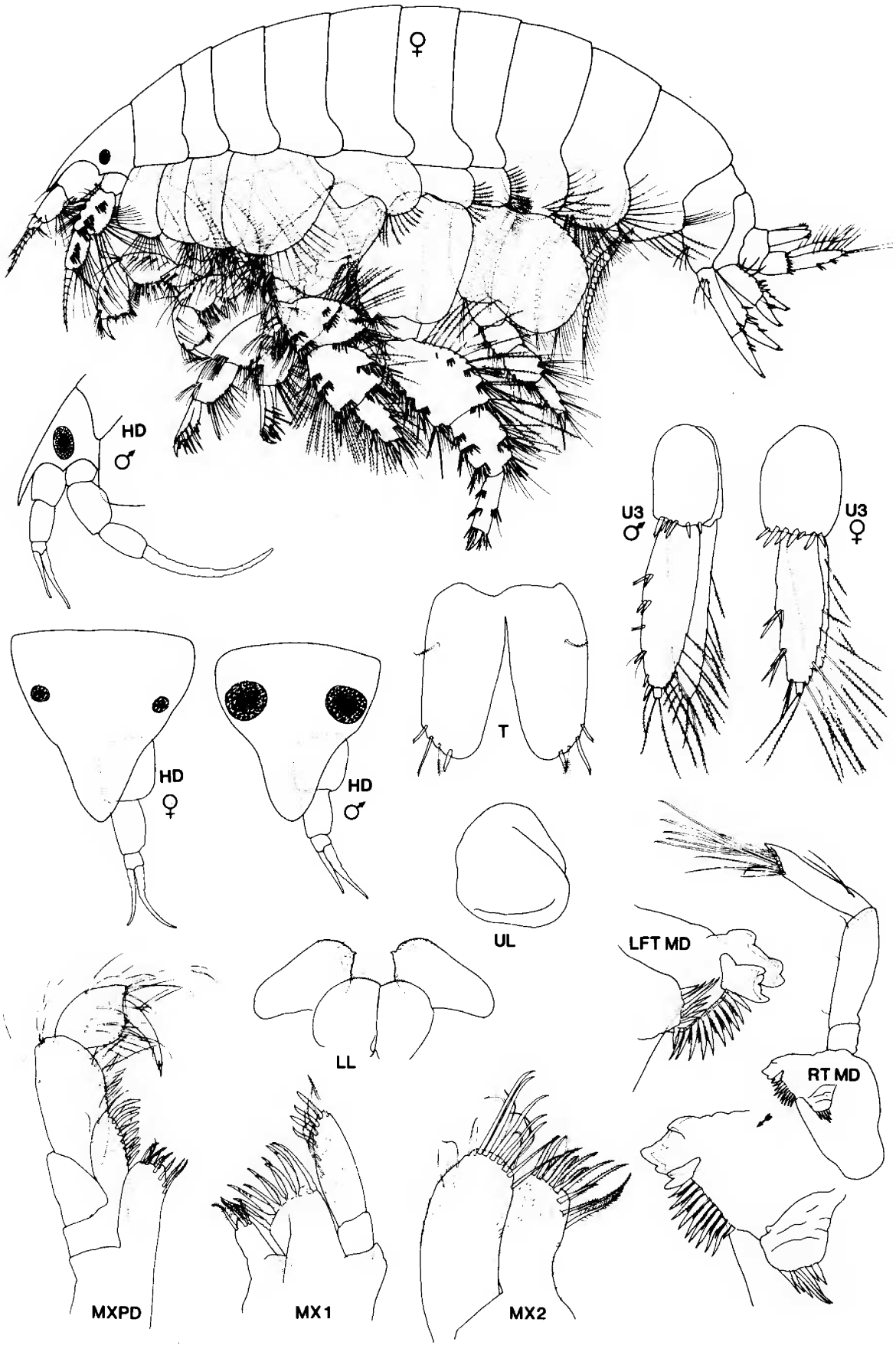
Coxae 1-3 large, deep, hind corners rounded, without cusps. Coxa 4 very large, hind process extending considerably under coxa 5, front and rear margins converging distally, rounded below. Gnathopods 1 & 2, carpus relatively short and deep; propods relatively short, broadening distally.

Peraeopod 5, basis medium large, hind margin convex; segment 4 slightly broader than deep, with 2-3 small postero-facial spine groups; segment 5 as wide as, but deeper than, segment 4; segment 6 slightly broadened, not longer than 5, hind margin with setae only; dactyl long, about 1/2 length of segment 6. Peraeopod 6, basis large, broadening distally, hind margin nearly straight; segments 4 & 5 little expanded, segment 4 distinctly the longer, with a few small postero-facial spine groups; segment 6 elongate, anterior and posterior margins with 3 small spine clusters; dactyl medium strong. Peraeopod 7, hind margin of basis with 6-7 weak serrations; segments 4 & 5 subequal; paired copulatory spines subequal, extending slightly more than half way along segment 6; dactyl slender.

Pleon plate 2 broadly rounding behind and below; pleon plate 3, hind corner slightly indented, with strong tuft of setae. Uropod 1, peduncle with 2-3 small outer marginal spines, but no distinct displaced spine; rami strong, with 5-

Fig. 10. ***Grandifoxus nasutus*** (Gurjanova). FEMALE (6.5 mm); MALE (5.5 mm).

(SEE PAGE 93 - OPPOSITE)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6 small posterior marginal spines. Uropod 2, peduncle with about 10 stout outer marginal spines; rami with 5-6 marginal spines. Uropod 3, rami strong, subequal, margins strongly plumose-setose, terminal segment distinct.

Telson lobes lacking dorso-lateral spines, each apex with 2-3 short spines.

Coxal gill very large on P2-6, small, drop-shaped on P7

Female: Unknown

Etymology. Prefix from the Greek root 'pseudes' meaning false, alluding to the similarity of this species to *G. nasutus.*

Distribution and Ecology. Known only from the type locality, Constantine Harbor, Amchitka, Alaska, in sand near shore.

Taxonomic commentary. Non-sex-linked character states of this form are generally similar to those of *G. nasutus,* as figured by both Gurjanova (1951) and Coyle (1982). However, the present male specimen differs in having shorter copulatory spines, more strongly spinose uropods 1 & 2, broader pleonal plates, and smaller telson spines.

Beringiaphoxus , new genus

Type species. *Beringiaphoxus beringianus,* new species.

Diagnosis. Pigmented eyes large, lateral, in both males and files. Rostrum large, hooded, not incised in front of eyes. Antenna 2 (female), peduncular segment 1 weakly or not ensiform; segment 3 with 3-4 lateral setae; segment 4 with single row of facial spines, anterior margin with setal clumps, but no spines; segment 5 with 2 rows of facial spines.

Mandible, molar weak, with slender marginal blades; spine row strong; left lacinia 4-dentate, right lacinia bifid; palp segment 2 not expanded. Lower lip broad, shallow. Maxilla 1 & 2 ordinary. Maxilliped, inner plate with 2 apical spines; palp, dactyl strong basally stout.

Coxae 1-3 large, increasing posteriorly, lower margins rounded, hind corners lacking cusps. Coxa 4 large, narrowing distally, lower margin rounded. Gnathopods 2, carpus stronger and deeper than in 1, propods broadening distally.

Peraeopods 3 & 4 very strong; 4 expanding distally, 5 short, deep. Peraeopod 5, segment 4 broader than deep, facial rows of spines strong. Peraeopod 5, basis very broad; segment 4 broader than deep; segment 5 longer than 4 but shorter than 6. Peraeopod 7, hind margin of basis with numerous (10+) teeth or serrations; segment 5 expanded, as broad as deep (copulatory spines of mature male unknown). All peraeopod dactyls medium.

Uropod 1, peduncle with baso-facial cluster of 5-6 setae, numerous (8+) outer marginal spines, but lacking displaced spine; rami long, spinose posteriorly. Uropod 2, peduncle and outer ramus marginally spinose; inner ramus bare. Uropod 3, rami markedly unequal (female), broad throughout, slightly tapering distally, terminal segment minute; in penultimate male rami broad, nearly subequal, inner margins plumose-setose.

Telson lobes broad, with dorso-lateral and apical spines. Coxal gills large, drop-shaped on peraeopods 2-6, slender on peraeopod 7.

Mature male unknown.

Taxonomic commentary. *Beringiaphoxus* exhibits many of the plesiomorphic character states of the *grandis - lindbergi* subgroup within the genus *Grandifoxus.* It differs from that genus mainly in its unconstricted, elongate rostrum; large eyes in both sexes; and broadened segment 5 of peraeopod 7. From the genera *Foxiphalus* and *Majoxiphalus* the present genus is separated (in combination) by the simple facial spination of the antennal peduncular segments; elongate carpus of the gnathopods; powerful form of peraeopods 3 & 4; short, broad segment 4 of peraeopod 6; broad rami of uropod 3 (both sexes), and to lesser extent the bispinose maxilliped inner plate and lack of displaced spine on uropod 1.

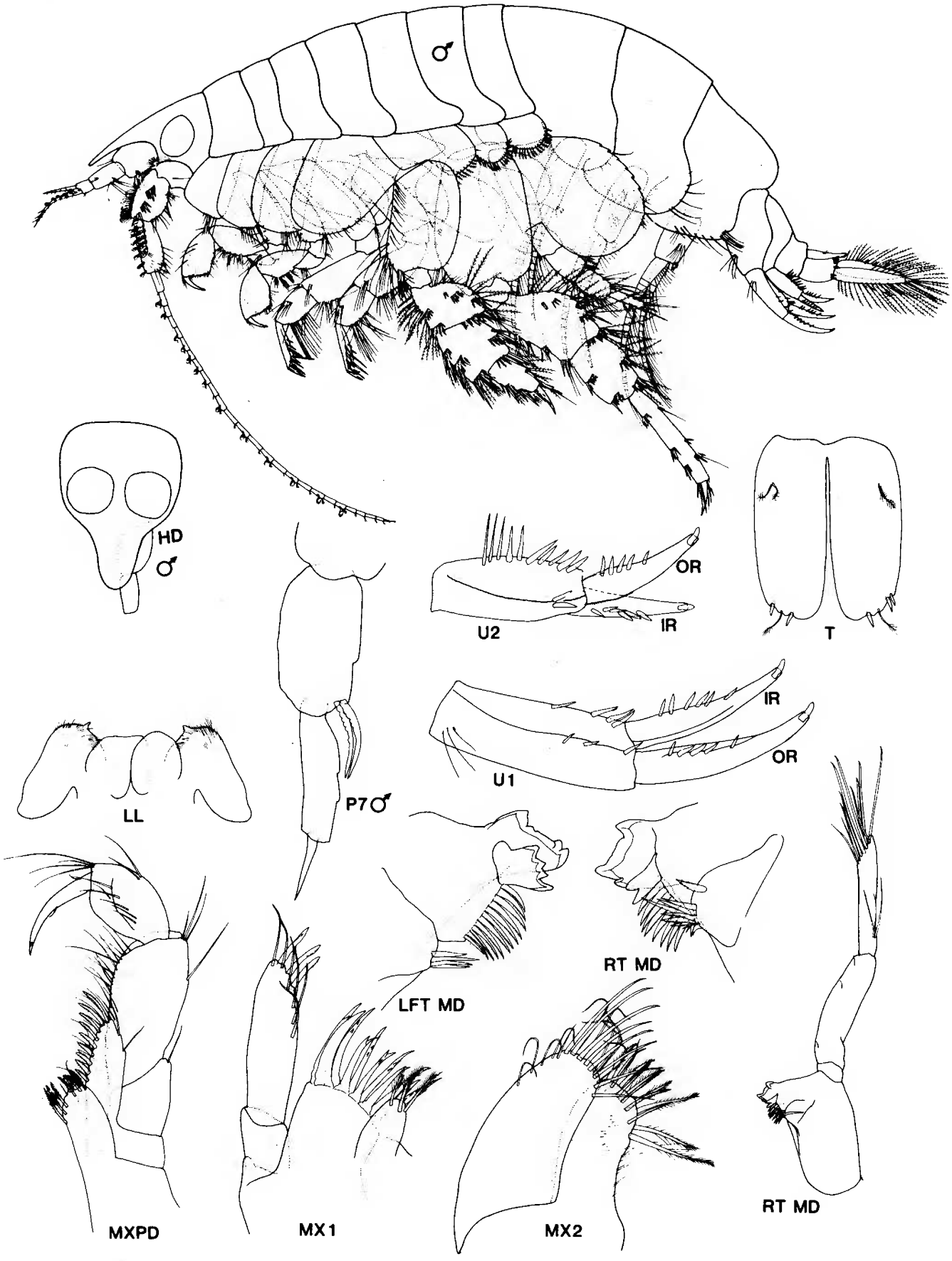
Beringiaphoxus beringianus, new species
(Fig. 12)

Material examined.
ALASKA: Bering Sea: Amchitka Island, Constantine Harbor, inter-tidal sand, P. Slattery coll., Sept. 15,1971:1 female br. II (9.5 mm) HOLOTYPE with slide mount, CMN Cat. No. NMCC1992-0629; 1 male penult (8.5 mm) ALLOTYPE with slide mount, CMN Cat. No. NMCC1992-0630; 7 female PARATYPES. CMN Cat. No. NMCC 1992-0715; Ibid; MLW sand, October 30, 1971 - 1 female Br. II (6.0 mm) with slide mount, 7 females, Br. I & II, PARATYPES, CMN Cat. No. NMCC 1992-0716.

Diagnosis. (Female br. II, 9.5 mm): Pigmented eyes large, subovate. Rostrum, apex long, extending to peduncular segment 3 of antenna 1. Flagellum of antenna 11-12 segmented, nearly twice the length of the accessory flagellum. Antenna 2, peduncular segment 4, facial spines in two linear groups of 7-8 spines each; segment 5 with 10-12 facial spines; flagellum 12-segmented.

Mandible, molar with 7-8 blades; spine row with 10-13 rakers and accessory setae; right lacinia bifid, separated from raker spines; left lacinia 4-dentate; incisors tricuspate; palp segment 3 with single cluster of long "A" setae. Upper lip,

Fig. 11. ***Grandifoxus pseudonasutus,*** new species. MALE (6.5 mm) HOLOTYPE.
(SEE PAGE 85 - OPPOSITE)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epistome not produced. Lower lip, shoulder cusps distinct. Maxilla 1, palp segment 2 apex subacute, slope with several slender spines. Maxilliped, outer plate with 13 inner marginal serrate masticatory spines.

Coxal plates 1-3, lower hind margins strongly long-setose. Gnathopods slightly unequal, carpus of gnathopod 2 distinctly shorter and deeper than 1; propod palms vertical.

Peraeopods 3 & 4, segment 5 much shorter than 4, postero-distal spine longer than adjacent setase, about 2/3 length of slender spinose segment 6. Peraeopod 5, basis broad, margins subparallel segment 4 broader than wide; segment 5 less wide, but deeper than 4, with single postero-facial row of spines; segment 6 about equal in length to 5, hind margin setose. Peraeopod 6, basis very broad, hind margin slightly convex; segment 4 as broad as deep, with 1 distinct postero-facial spine group; segment 5 less broad but longer than 4, with one postero-facial spine group; segment 6 with 3 groups of anterior and posterior marginal spines. Peraeopod 7, segment 5 very broad, hind marginal teeth numerous weak; expanded segment 6 with numerous long posterior marginal setae; segment 6 distinctly longer than 5, margins setose.

Pleon plate 2, hind corner rounded; pleon plate 3, hind corner notched, with strong tuft of posterior setae. Urosome 3 with cluster of postero-ventral setae. Uropod 1, with baso-facial group of setae and 8-10 outer marginal spines; rami long, curved, outer ramus with about 10 posterior spines. Uropod 2, outer ramus with 5 posterior spines, inner ramus bare. Uropod 3, inner ramus about half length of outer, plumose setose at apex; outer ramus, terminal segment minute.

Telson lobes broad, each with 2-3 dorso-lateral spines in tandem, oblique apices each with 1-2 short spines.

Male, penultimate (8.5 mm): Pigmented eyes horizontally subovate, lateral. Antenna 2, flagellum of more than 20 segments, proximally conjoint. Uropod 3, inner ramus short-plumose setose on both margins; outer ramus, terminal segment with 2 apical plumose setae.

Etymology. Named after its type locality in the Bering Sea.

Distribution and Ecology. Intertidal and shallow-water sands; to date known only from Amchitka Island, southern Bering Sea, the type locality.

Taxonomic commentary. The species differs from some species of *Grandifoxus* (esp. the *longirostris* group and *G. Iindbergi)* in lacking a displaced spine on uropod 1, in lacking spines on the inner ramus of uropod 2, but possessing large pigmented eyes in both sexes. Because of the fully hooded rostrum, the species may bear a certain superficial resemblance to primitive species of *Foxiphalus,* especially *F. aleuti,* which also has a bifid right lacinia, and apically bi-spinose maxilliped inner plate. However, *Beringiaphoxus* is distinguished from *F. aleuti* by its large eyes, dissimilar carpi of the gnathopods, more powerful peraeopods 3 & 4, broadly expanded segment 4 of peraeopod 6, spinose uropods 1 & 2 (lacking displaced spine), and broad uropod rami. The form and calceolation of peduncular segment 5 of antenna 2, and form of the copulatory spines of P7, are unknown, but are needed to establish more precise phyletic relationships of *Beringiaphoxus.*

Majoxiphalus, new genus

Foxiphalus Barnard, 1979: 372 (partim).---Barnard & Karaman, 1991: 609 (partim).

Type species. *Foxiphalus major* Barnard, 1960: 259.

Species. *Majoxiphalus maximus,* new species.

Diagnosis. Pigmented eyes very small (female). Rostrum elongate, not incised in front of eyes, apex acute. Antenna 1, segment 2 slightly longer than segment 1. Antenna 2, segment 1 weakly ensiform, segment 3 lacking lateral setae; segment 4, facial spines in 3 linear clusters; anterior margin with clusters of setae, not spines; segment 5, facial spines in single long submarginal row (female), with 7 anterior marginal calceoli (male); flagellum (of male) short, segments alternately calceolate.

Mandible, molar small with 8-10 marginal blades; spine row strong; left lacinia 4-dentate, right lacinia irregularly bifid; palp segment 2 broadened, setose; segment 3, with two clusters of "A" setae, apex strongly oblique. Lower lip tall, shoulder cones weak. Maxilla 2, inner and outer plates subequal in width. Maxilliped inner plate with 2 (1-3) apical spines, outer plate slender, palp medium strong, dactyl slender.

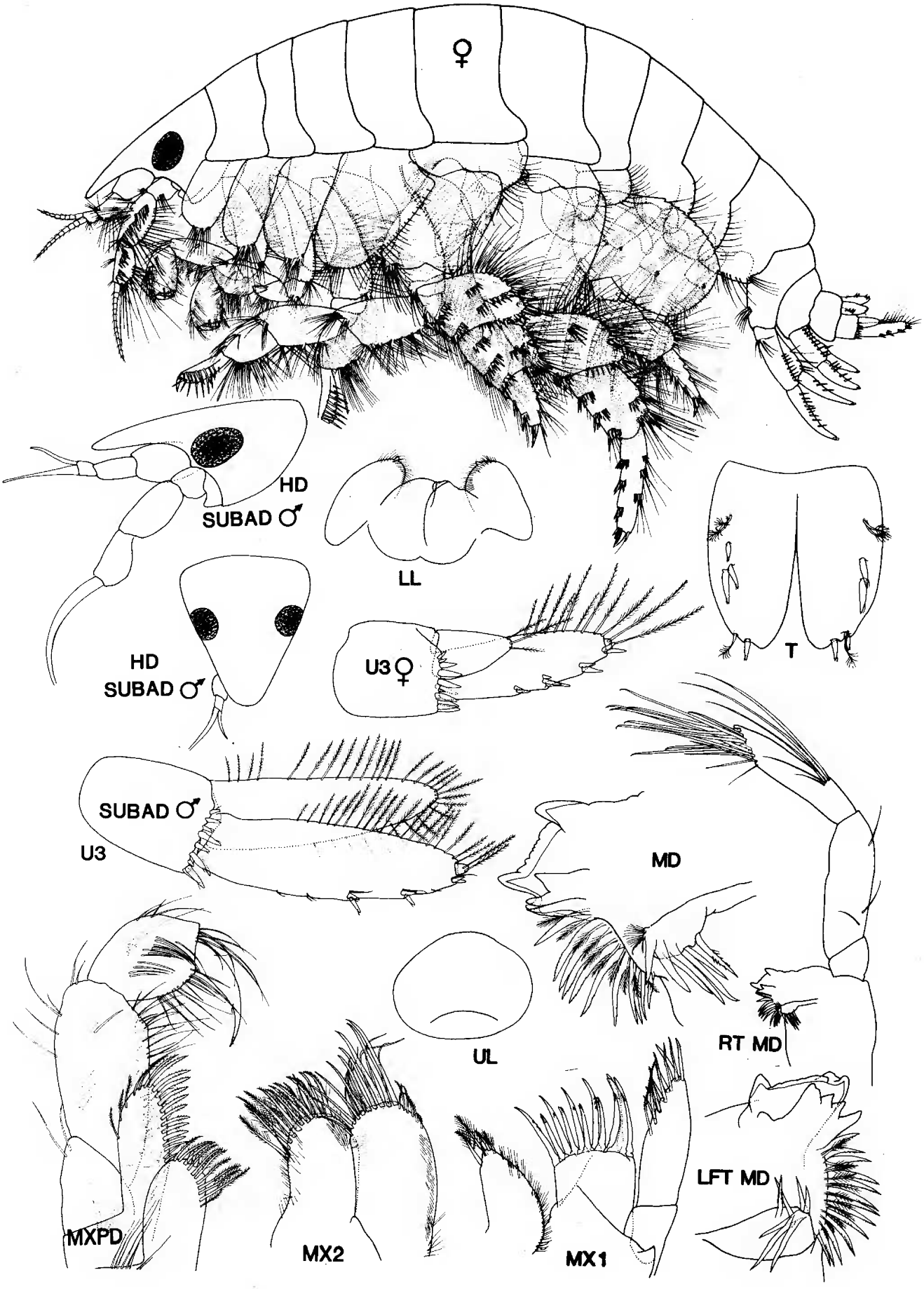
Coxal plates 1-3 large, deep, lower margins strongly setose. Coxa 4 very large, hind margin arcuate. Gnathopods 1 & 2 differing in strength of carpus: gnathopod 2, carpus with medium-short posterior lobe; propod subovate, palm oblique.

Peraeopods 3 & 4 very powerful, segment 5 short and deep, postero-distal spine strong, long, accompanied by 1-3 slender accessory spines; segment 6 elongate, marginal spines slender, very numerous; dactyls very small. Peraeopod 5, segment 4 broader than deep; segment 5 narrower and deeper than 4, segment 6 longer than 5, hind margin strongly setose. Peraeopod 6, basis large, subovate; segments 4 & 5 little broadened, elongate; segment 6 elongate, margins spinose; dactyl strong. Peraeopod 7, segments 4 & 5 broadened, 5 longer than 6, copulatory spines elongate, slender, setulose distally; dactyl long.

Pleon plates 2 & 3, hind corners subacute, hind margin richly setose. Urosome 1 with ventral cluster of setae. Uropod 1 peduncle baso-facially richly setose; inner margin

Fig. 12. ***Beringiaphoxus beringianus*** new genus, new species. FEMALE br. II (9.5 mm) HOLOTYPE. MALE subadult (8.5 mm) PARATYPE.

(SEE PAGE - OPPOSITE)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spinose, distal displaced spine strong; rami long, finely spinose. Uropod 2, rami long, outer ramus spinose, inner ramus weakly spinose or unarmed. Uropod 3, rami sub-equal, lanceolate (both sexes), margins weakly (female) setose; terminal segment distinct, with 1-2 short apical setae.

Telson lobes narrowing distally, with 1-4 spical spines, dorso-lateral spines lacking.

Coxal gills large, broad, on peraeopods 2-7.

Etymology. Anagrammic combination of "major", the type species, with parts of 'phoxus' (hooded), and 'cephalus' (head).

Taxonomic commentary. This genus has been separated from *Foxiphalus* based on the distinctive morphology of its type species, *M. major* (Barnard). In its several plesiomorphies of ambulatory appendages and mouthparts, *Majoxiphalus* is more closely related to *Beringiaphoxus* and *Grandifoxus* than to *Foxiphalus* (see Discussion, p. 126)

Key to species of *Majoxiphalus*

1. Uropods 1 & 2, outer rami marginally spinose to apex; gnathopod 2, carpus posterior lobe long, about half length of anterior lobe, setae in 2+ clusters; telson, apices each with 3+ spines; . . . . . *Majoxiphalus maximus* (p. 90).

----Uropods 1 & 2, outer rami spinose proximally, distal 1/3 bare; gnathopod 2, carpus posterior lobe short, less than half length of anterior lobe, setae in one big cluster; telson lobes each with 1-2 apical spine. *Majoxiphalus major* (p. 88)

Taxonomic commentary. Members of this genus combine a number of plesiomorphic character states, with specialized features that remove it from the genus *Foxiphalus*, as here defined. The principal differences are: very elongate rostrum; strongly calceolate peduncle 5 of antenna 2 (male); very powerful peraeopods 3 & 4 with several postero-distal spines on segment 5; the unique mandibular palp; elongate rami of uropods 1 & 2; sub-equal rami of uropod 3 (both sexes), and the slender telson lobes that lack dorso-lateral spines.

Distribution and Ecology. The two known species (and variants) are North American Pacific endemic. The records indicate that the component species may be associated with fine, often silty, or partly anaerobic 'black' sands, in semiprotected deposition zones.

Majoxiphalus major (Barnard, 1960)
(Fig. 13)

Paraphoxus major Barnard, 1960: 259, pl. 32.
Foxiphalus major Barnard & Barnard, 1982a: 12, fig. 1.—Barnard & Barnard, 1991: 610.

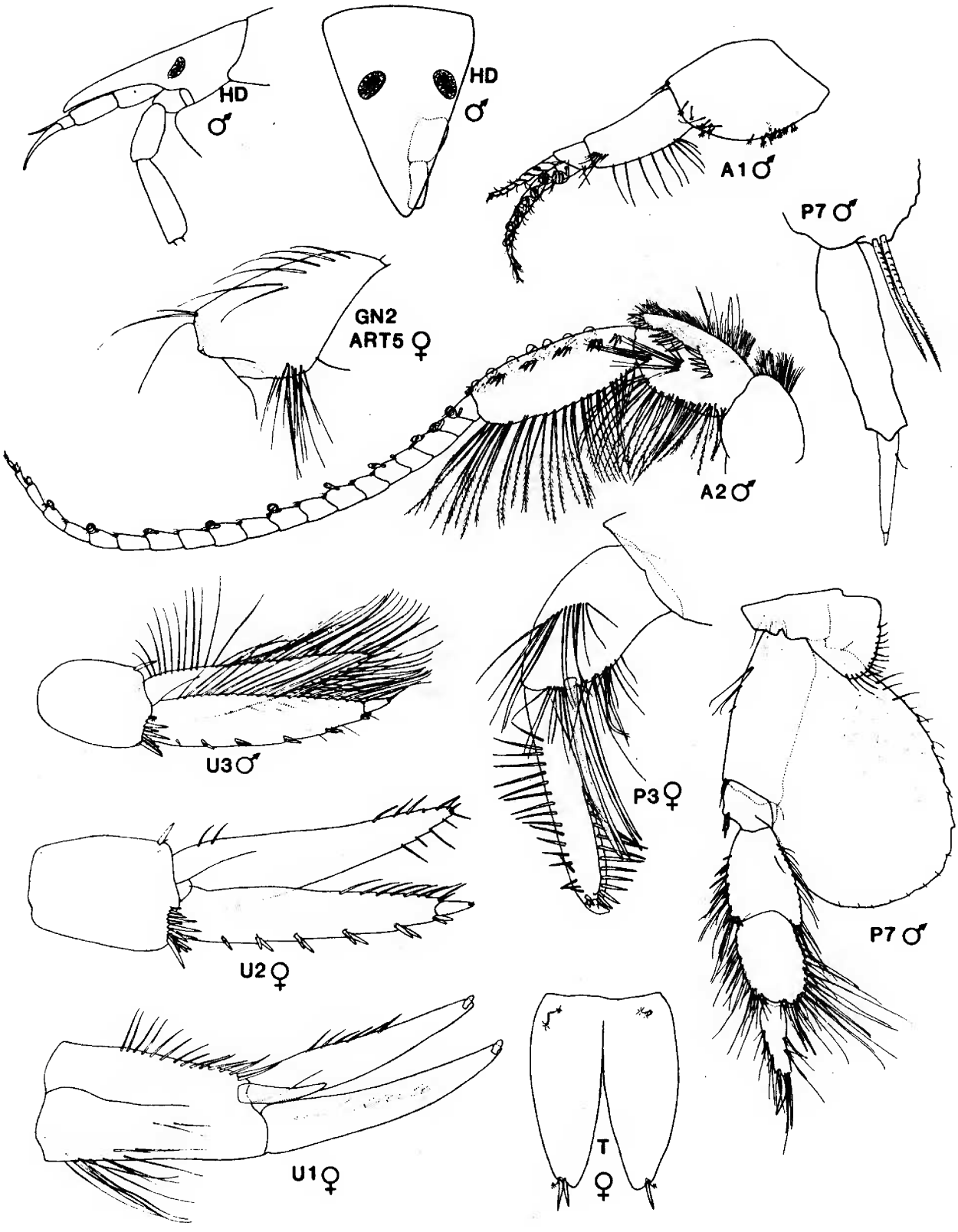
Material examined.
SE ALASKA: Kruzof I., Kamenoi Pt., dredge 9m, stones and (black) sand, ELB Stn. S18F3, Aug. 2,1980. - 1 male (subadult), 6 imm.; Chichagof I., Column Pt., Lisianski Strait, LW and subtidal fine black organic sand, ELB Stn. S11B3, July 30, 1980: 1 male; Ibid, dredge, 3-6 m, 511 Fl: 1 female ov., 5 subadult females, 1 mature male.
BRITISH COLUMBIA: Queen Charlotte Islands: Parry Passage, Kiusta, LW sand, ELB Stn. H2a, August 24,1957:1 female imm. (6.0 mm) with slide mount.
Hecate Strait, PRG 5-1-16, Stn. 36, from fish stomach, Mar. 21, 1965, (C. Low donor): 1 female br. II (14.0 mm) with slide mount.
Central Coast: Bolivar Island, grab, 15 m., ELB Stn H59, Aug. 9, 1964: 1 female ov. (15.0 mm.) with slide mount, fig'd, 1 mature male (10.5 mm) with slide mount, fig'd., 8 immatures. CMN Cat. No. NMCC1992-0631. Oval Bay, ELB Stn. H10, in sand at LW level, July 12, 1964: 1 female br. II (12.5 mm) with slide mount, 60 immatures.
Vancouver Island: Barkley Sound, Trevor Channel off Long Reach, coarse sand at 30 m., ELB Stn. P10, July 29,1975: 1 imm. female; off Bordelais Islets, fine sand, 44 m., ELB Stn. P21a, August 9, 1975: 3 subadult females (1 photographed), 6 juveniles. Pachena Bay, from gray whale pits in sand, 15-25 m., P. Slattery Stns.: Pit 1, September 16,1982: 1 female br. II, 3 juv., with slide mount of imm. female (5.5 mm); Pit 3, July 25, 1982, 1 female br II (slide mount); April 17, 1983 - 1 subadult female.
WASHINGTON: Crescent Beach, LW, clean sand above black sand, ELB Stn. W34, July 27, 1966: 1 subadult female, 4 juveniles. Juan de Fuca Strait, Off San Juan Island, Strait of Juan de Fuca, C. P. Staude Stn. KBG-10, June 3, 1976: 10 specimens with slide mount of 1 female ov. (12.0 mm).

Diagnosis. (Female ov., 15.0 mm) (supplementing Barnard (1960), and Barnard & Barnard (1982a)): Pigmented eyes small, ovate. Maxilla 1, inner plate with 4 apical setae. Maxilliped, inner plate with 2 (1-3 occasionally) apical spines; outer plate short, usually extending less than half segment 2 of palp.

Coxa 4, hind margin smoothly rounded. Gnathopod 1, carpus, posterior lobe medium, length about half anterior margin; gnathopod 2 carpus, hind lobe short, rounded, setae in one main cluster.

Peraeopod 5, segment 4, width about 25% greater than depth, proximal margin strongly rounded, postero-facial row of about 8-10 spines; segment 6 little expanded, nearly twice as long as wide; dactyl short. Peraeopod 6, segments 4, 5, & 6 moderate, combined length about 50% great than length of basis. Peraeopod 7, basal lobe rounded not produced posteriorly.

Fig. 13. ***Majoxiphalus major*** (Barnard).
FEMALE. (15.0 mm); MALE (10.5 mm)
(SEE PAGE 89 - OPPOSITE)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Uropod 1, displaced spine very strong, length nearly 1/3 length of inner ramus; distal one-third of rami lack posterior slender spines. Uropod 2, distal third of outer ramus, and all of inner ramus, lack posterior slender spines. Uropod 3, inner margin of rami with short simple setae near apex only. Telson lobes usually each with 2 apical spines and single setule.

Coxal gills not described.

Male (mature, 10.5 mm). Rostrum slightly shorter and broader than in female, apex less acute. Eyes medium small, ovate (in northern material), large, rounded, nearly meeting mid-dorsally (in Californian material). Antenna 1, flagellum, proximal 7 segments calceolate. Antenna 2, peduncular segment 5 with 7 anterior marginal calceoli and 5-6 submarginal facial spine groups, posterior margin heavily plumose-setose; flagellum 20-segmented, distal segments alternately calceolate.

Peraeopod 7, segment 5, copulatory spines elongate (about 3/4 length of segment 6), nearly straight, distally setulose.

Uropod 3, inner margins of rami very heavily armed throughout with long plumose setae.

Distribution and ecology. Southeastern Alaska (Sitka region) and British Columbia, south to central, and Baja California, in fine sand (just above reducing layer) from LW levels (in north) and sub-tidally to depths of 91 m. at Californian stations.

Taxonomic commentary. Considerable variation has been noted in character states of the mouthparts, gnathopods, uropods and telson throughout the range of materials at hand and those described by Barnard (1960) and Barnard and Barnard (1982). The possibility that still other species (than *M. maximus,* new species) are masked by such variation awaits the study of more extensive material.

Majoxiphalus maximus, new species
(Fig. 14)

Material examined.
ALASKA: Bering Sea, St. Lawrence Island, subtidal sand, P. Slattery coll., June, 1983:1 female ov. (15 mm).
BRITISH COLUMBIA: Vancouver Island: Ahous Bay, LW sand, ELB Stn. 012, Aug. 8,1959: female ov. (18.0 mm) HOLOTYPE with slide mount, CMN Cat. No. NMCC1992-0632, 1 female ov. (15 mm), PARATYPE, CMN Cat. No. NMCC 1992-0633. McKenzie Beach, LW sand, ELB Stn. P703, July 7, 1970: 1 female subad. (13.0 mm) with slide mount, 23 juveniles.

Diagnosis. (Female ov., 18.0 mm): Eyes very small weakly pigmented. Rostrum sharply elongate, apex extending almost to base of 12-segmented flagellum of antenna 1. Accessory flagellum 10-segmented. Antenna 2, segment 4, facial spines in 3 clusters of 5, 4 and 5-6; segment 6 not longer than 5, with submarginal facial row of 12-14 spines; flagellum 14-segmented.

Mandible, molar with 9-11 marginal blades; spine row with 10-12 rakers and accessory setae; left lacinia irregularly 4-dentate; right lacinia bifid, closely approximated to raker spines; incisor broad, with 3 cusps; palp segment 2 stout, with numerous setae on both margins; segment 2 with 2 tightly approximated clusters of medium-long "A" setae. Maxilla 1, inner plate with 3 apical setae. Maxilliped, inner plate with 2 strong apical spines; outer plate slender, extending more than half length of palp segment 2, inner margin with 10-11 slender masticatory spines.

Coxa 4 very broad, broader than deep, posterior margin divided into vertical and oblique portions. Gnathopod 1, carpus long and slender; gnathopod 2, carpus shorter, hind lobe nearly half length of anterior lobe, setae in 2+ clusters; propods slender, subovate, longer than respective carpus.

Peraeopods 3 & 4, segment 5, postero-distal spines slender, tips reaching 3/4 length of segment 6; segment 6, marginal spines long, slender, 14-18 on each side, more numerous on outer margin. Peraeopod 5, basis medium broad, hind margin nearly straight; segment 4, width more than 50% greater than depth; disto-facial spine row with 12 + spines; segment 5 expanded, slightly deeper than wide, with no postero-facial spines; segment 6 as long as 5, hind margin setose; dactyl slender. Peraeopod 6, basis expanding distally, rounded below; segments 4 & 5 elongate, little expanded segment 6 elongate, nearly equal to 4 & 5 combined, margins with 5-6 clusters of spines; dactyl, strong, curved. Peraeopod 7, basis subcircular, wider than deep, postero-proximal margin with 5-6 low serrations; segment 5 & 6 stout, width about equal to length; segment 6 slender, not longer than 5; dactyl slender.

Pleon side plates typical of genus, lower margins strongly setose. Uropod 1, peduncle with 4-5 baso-facial clusters of long setae, displaced spine medium strong, about 1/4 length of inner ramus; posterior marginal spines of rami numerous, reaching tips. Uropod 2, outer ramus with about 20 slender posterior marginal spines, nearly reaching apex, inner ramus bare. Uropod 3, rami strongly plumose-setose along inner margins.

Telson lobes, apices each with 3-4 slender spines and a setule. Coxal gill on peraeopod 2 large, broad, tip subacute.

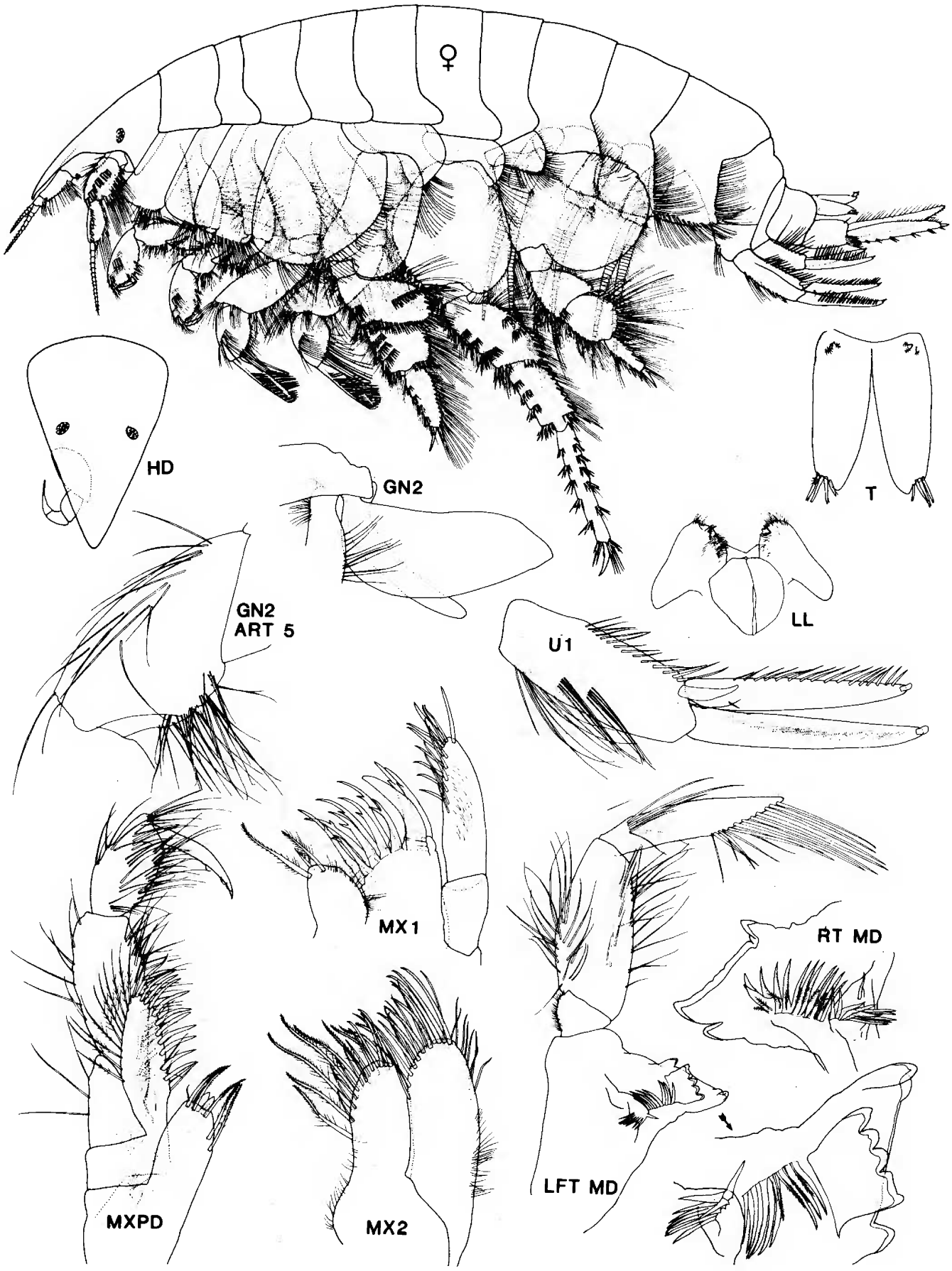
Mature male unknown.

Etymology. From the Latin 'maximus', referring to the large size of the animal, the largest species known to date.

Distribution and Ecology. Known only from three records, Bering Sea to northern Vancouver Island, in fine sand, LW and sub-tidally. The rarity of this species in collections from sandy beaches may indicate a very special-

Fig. 14. ***Majoxiphalus maximus***, new species. FEMALE ov. (18.0 mm) HOLOTYPE.

(SEE PAGE 91 - OPPOSITE)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ized habitat, perhaps associated with fine silty, or anaerobic conditions, not frequently sampled.

Taxonomic commentary. This species is easily distinguished from the type species, *M. major,* by the characters given in the key and in other descriptive details. In the region of distributional overlap, the two species did not occur in the same lots, although ecological requirements appear similar.

Foxiphalus Barnard, 1979

Foxiphalus Barnard, 1979: 372.—Barnard & Barnard, 1982a: 4 (key).—Barnard & Karaman, 1991: 609.

Type species. *Foxiphalus obtusidens* (Alderman, 1936).

Species. *Foxiphalus falciformis,* new species (p. 94); *Foxiphalus xiximeus* Barnard & Barnard, 1982a; *Foxiphalus fucaximeus*, new species (p. 100);*Foxiphalus aleuti* Barnard & Barnard, 1982; *Foxiphalus similis* Barnard, 1960; *Foxiphalus slatteryi,* new species (p. 106); *Foxiphalus cognatus* Barnard, 1960.

Diagnosis. Pigmented eyes very small to medium in female, medium to large in male. Rostrum fully hooded, not incised in front of eyes. Antenna 1, peduncle 2 distinctly shorter than 1. Antenna 2, peduncular segment 1 variously ensiform, segment 3 with 1 lateral seta; segment 4, facial spines in three distinct groups, anterior margin with a few setae but no spines; segment 5 with 1- 2 clusters of facial spines, and 1-2 distal anterior marginal calceoli in male. Flagellum medium in female (length about equal to peduncle 5 & 6), elongate (20 + alternately calceolate segments) in the male.

Mandible, molar with few (5-10) marginal blades; spine row (rakers) medium strong; left lacinia irregularly 4-dentate or modified; right lacinia simple, (occ. bifid or lacking) often adjacent to spine row; incisors broad, bicuspate; palp slender, segment 2 weakly setose; segment 3 with one cluster of "A" setae, apex obliquely truncate. Upper lip, epistome occasionally with sharp anterior process. Lower lip broad, with distinct shoulder cusps. Maxilla 1 outer plate, one outer apical spine enlarged; inner plate with 2-4 apical setae. Maxilla 2, outer plate usually broader than inner. Maxilliped, inner plate with 1 (occ. 2) apical spine(s); outer plate slender, short (not reaching half of palp segment 2); dactyl slender.

Coxae 1-3 medium deep, increasing posteriorly. Coxa 4 large, margins sub-parallel or converging distally. Gnathopods 1 & 2, propods medium strongly sub-chelate, longer than respective carpus palms oblique; carpal lobe of gnathopod 2 very short.

Peraeopods 3 & 4 medium strong, segment 5 with single postero-distal spine; segment 6 spinose distally; dactyl relatively long. Peraeopod 5, basis medium, broad, regular; segment 4 moderately to broadly expanded, occasionally not wider than deep, facial clusters of spines lacking; segment 5 usually deeper than broad, lacking postero-facial spine clusters; segment 6 longer than 5, hind margin setose; dactyl slender, long. Peraeopod 6, basis typically expanding distally; segment 4 not broadened, length often twice its width, lacking facial spines; segment 6 not broadened, not longer than 4 or 6, hind margin with a few long plumose setae and occasionally short spines; segment 6 slender hind margin with 3A weak cluster of spines and single setae; dactyl slender, long. Peraeopod 7, basis with weak posterior marginal serrations; segments 4, 5, and 6 increasing in length distally, 4 & 5 little broadened; copulating spines (in male) slender sub-equal, straight or slightly decurved, proximally weakly denticulate, distally finely setulose.

Urosomite 1 variably with ventral brush of setae. Uropod 1, peduncle usually with single cluster of baso-facial setae, with strong inner marginal, but few or no, outer marginal spines; displaced spine present, usually strong; rami medium, with few posterior marginal spines, apical spines fixed or articulating. Uropod 2, outer margin strongly spinose; rami short, outer few spinose, inner bare. Uropod 3, inner ramus usually distinctly shorter, and marginally smooth in female; sub-equal and strongly plumose-setose in male.

Telson lobes slightly narrowing distally, usually with 1 dorso lateral spines; apices each with 1-3 (4) variable spines and a single plumose setule.

Coxal gills large, ovate or elongate on P2-6, small on P7.

Taxonomic commentary. Members of the genus *Foxiphalus* exhibit the most extensive combination of apomorphic character states of the seven genera formally assigned to subfamily Metharpiniinae. These include mainly reductions in, or modifications of, the mandibular molar, right lacinia, maxilla 1 spines and setae, maxilliped inner plate spines; more powerfully developed gnathopod carpus and propod; more slenderized and less spinose peraeopods, with longer dactyls; reduced size and armature of the uropods, and reduction in telson spination. Especially apomorphic is the reduction in numbers of calceoli on peduncular segment 5 and flagellar segments of antenna 2 in the male.

The genus contains 10 described species, but the illustrations and descriptive remarks of Barnard (1960) and Barnard & Barnard (1982) suggest that additional taxa from the region of Central and southern California await formal recognition. *'Pararpinia' simplex* Gurjanova 1938, from the Sea of Japan, is superficially similar to the *similis* group of *Foxiphalus,* but the balance of generic character states places it more naturally with the Paraphoxinae (Eobrolginae).

Distributional Commentary. The 10 described species of the genus *Foxiphalus* are North American Pacific endemic. However, only five of these *(F. xiximeus, F. fucaximeus, F. similis, F. slatteryi,* and *F. aleuti)* have yet beee been recorded here. The five others (of Table XII) occur from Central California south to Panama, mostly in cold-water areas or regions of upwelling at southern locations, in depths of 50-100 m, and occasionaluy to 300 m.

Key to regional species of *Foxiphalus*

1. Peraeopod 5, segment 4 very broad, width usually more than 1.5 X depth (length); uropod 3 (female), inner ramus longer than 1/2 the outer ramus, inner margin plumose-setose; telson lobes each with dorso-lateral spine(s) ..... 2.

—Peraeopod 5, segment 4 little expanded, width little greater than depth; uropod 3 (female), inner ramus short, margins bare, less than half length of outer ramus; telson lobes lacking dorso-lateral spine(s). ..... 5.

2. Peraeopod 5, segment 5 wider than deep; peraeopod 6, segment 4 moderately expanded, length not greater than 1.5 X width; uropod 1, outer ramus with 0-1 posterior marginal spines; pleon plate 2, lower margin densely setose ..... 3.

—Peraeopod 5, segment 5 deeper than wide; peraeopod 6, segment 4 little broadened, length at least 2 X width; uropod 1, outer ramus with 2-4 small posterior marginal spines; pleon plate 2, lower margin with a few (3-6) scattered setae ..... 4.

3. Uropods 1 & 2, outer ramus with 1 (2) posterior marginal spines; gnathopod propods medium, distally broadening, longer than carpus; telson lobes each with medium dorso-lateral spine and single apical spine ..... ***F. xiximeus*** (p. 98)

—Uropods 1 & 2, outer ramus with O (occ. l) posterior marginal spines; gnathopod propods small, little longer than carpus, margins subparallel; telson lobes each with stout dorso-lateral spine and two unequal apical spine ..... ***F. fucaximeus*** (p. 100)

4. Uropod 1, outer ramus with 3-4 short posterior marginal spine peduncular displaced spine stout; telson lobes, dorso-lateral spine small; mandible, left lacinia 4-5 dentate . . ***F. obtusidens*** (p. 94)

—Uropod 1, outer ramus with 2 short posterior marginal spines; peduncular displaced spine lacking; telson lobe, dorso-lateral spine long, slender; mandible, left lacinia sickle-shaped ..... ***F. falciformis*** (p. 94)

5. Peraeopods 3 & 4, segment 5, postero-distal spine massive, 5-6 times width of adjacent setae; upper lip, epistome not produced; peraeopod 7, segment 5 expanded, ovate, hind margin densely setose; uropod 1, outer ramus with 4 posterior marginal spines ..... ***F. aleuti*** (p. 98)

—Peraeopods 3 & 4, segment 5, postero-distal spine normal, slender, about 2-3 X width of adjacent setae; upper lip, epistome moderately to strongly produced to a sharp apex; peraeopod 7, segment 5 not broader than 4, hind margin sparsely setose; uropod 1, outer ramus with 3 (occ. 4) medium posterior marginal spines ..... 6.

6. Peraeopod 5, segment 5 narrowing distally; epistome moderately produced, length not exceeding basal width; pleon plate 3, hind margin with 3 setae closely bunched near hind corner ..... ***F. cognatus***

—Peraeopod 5, front and hind margins subparallel; epistome strongly produced, length exceeding basal width; pleon plate 3, setaespread widely along hind margin ..... 7.

7. Coxa 1, lower margin setose almost throughout; coxa 4, margins slightly converging distally, lower margin broad, flat; telson lobes each with 3 small apical spines ..... ***F. similis*** (p. 102)

—Coxa 1, lower margin setose along posterior half only; coxa 4, margins strongly converging distally, lower margin rounded; telson lobes each with 2 normal but unequal apical spines ..... ***F. slatteryi*** (p. 106)

Foxiphalus obtusidens (Alderman, 1936)

Pontharpinia obtusidens Alderman, 1936: 54, figs. 1-13. —Barnard, 1954: 4.
Paraphoxus obtusidens Barnard, 1960: 249.---Barnard, 1975: plate 72 (22).
Foxiphalus obtusidens Barnard & Barnard, 1982a: 4, fig..l.

Material examined. The species has apparently not yet been taken in the study region, but might be expected in southern Oregon.

Diagnosis. Although reasonably well described by previous authors (loc. cit. above), at least three species may be included in the figures of Barnard (1960). One of these (his Plate 37) has already been removed to the synonomy of *F. golfensis* by Barnard and Barnard (1982). Two other probably distinct species are represented in Barnard's 1960 Plate 35 and Plate 36 (figs, A-F). Moreover, despite limitations of Alderman's 1936 original description and figures, they do differ in a number of important details even from those of Barnard's plate 34 (1960) on which the latter author bases his redescription of *F. obtusidens.* However, failing careful re-examination of Barnard's material, and since his material is fully outside the present study region, these forms are not described, named, keyed, or otherwise included here.

The following summary of diagnostic character states of *F. obtusidens,* as treated by authors above (loc. cit.), is included for direct comparison with *F. falciformis,* new species (below).

Female (8.5 mm): Pigmented eyes separated dorsally by their length. Rostrum relatively long, apex subacute. Antenna 1, flagellum 9-10 and accessory flagellum 7-8 segmented. Antenna 2, segment 4 wilh 9-14 facial spines and 1 postero-distal long spine, anterior margin with cluster of 3 setae and 1 spine; segment 5 with 3- 5 facial spines; flagellum of 9-10 segments.

Mouthparts described but incompletely figured by Alderman (loc. cit). Barnard and Barnard (1982a) described the mandibular molar as small; right molar with 7 primary marginal blades and 1 disjunct (displaced) blade, left molar with 5 blades and a disjunct blade; spine row with 10 short curved rakers; right lacinia unequally bifid, adjacent to spine row; left lacinia 5-dentate (not falciform). Upper lip, epistome not produced, ridge-like. Lower lip with shoulder cones. Maxilla 1, outer plate with enlarged outer apical spine. Maxilliped inner plate with 1 apical spine; inner plate with 10 setulose masticatory spines on inner margin.

Coxae 1-3, lower marginal setae confined to postero-distal corner. Coxa 4, lower margin strongly rounded and continuous with anterior and posterior margins. Gnathopods 1 & 2 medium strong. Gnathopod 2, carpus short, with 1-2 posterior clusters of setae. Peraeopods 3 & 4 moderately strong, segment 5, postero-distal spine stout, length about 2/3 segment 6, having fossorial spines confined to distal end only; dactyl strong. Peraeopod 5, segment 4 little expanded, width about 1.3 X depth (length), lacking postero-facial spines; segment 5 about as wide as deep, longer than 4. Peraeopod 6, segments 4, 5, and 6 relatively short, 4 little expanded, 5 shortest, dactyl medium. Peraeopod 7 unremarkable.

Uropod 1, peduncle with 4-5 medium strong inner marginal spines; displaced spine strong, reaching nearly to pair of posterior marginal spines of the inner ramus; outer ramus with 4 posterior marginal spines; both rami with single articulated apical spines.

Uropod 2 peduncle, outer margin with 8 strong spines; outer ramus with 4 posterior marginal spines; inner ramus marginally bare. Uropod 3, inner ramus nearly equal to proximal segment of outer ramus, both margins plumose-setose distally; outer ramus weakly plumose on inner margin; terminal segment distinct.

Telson lobes broadest medially, each with single short dorsolateral spine; apices rounded, each with 2 sub-equal slender spine and single setule.

Male (5.0 mm): Not described or illustrated by Alderman (1936). Antenna 1 primary flagellum of 11 segments, calceolate on the proximal 2. Copulatory spines of peraeopod 7 not described.

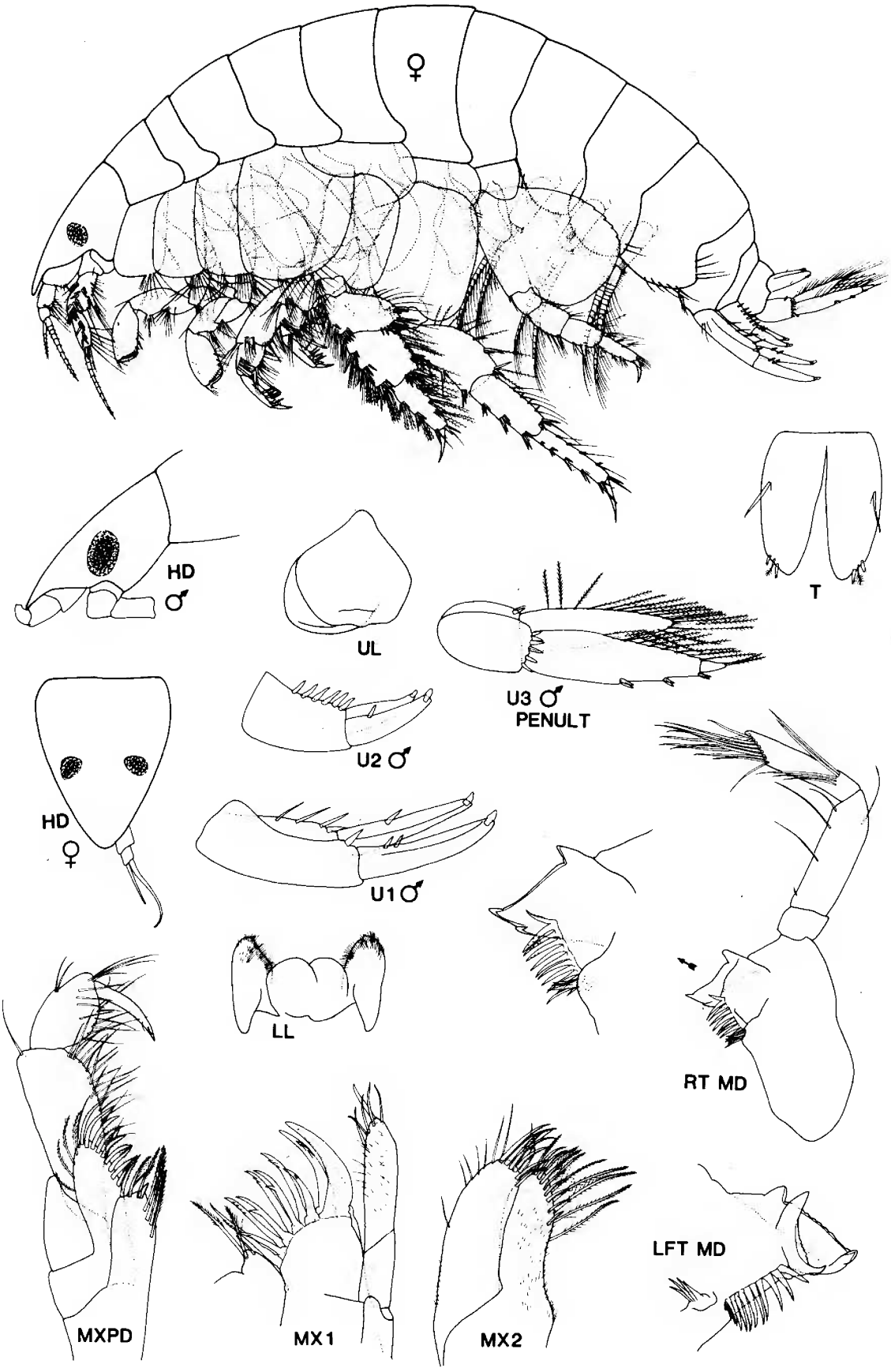
Distribution and Ecology. Off the central California coast, taken from among kelp hold-fasts (presumably close to sandy substrata). Barnard and Barnard (1982a) extend the range from Monterey Bay, central California, southwards to Isla Cedros, Baja California, in subtidal depths, shoreline to 210 m.

Taxonomic commentary. The *obtusidens* group is distinguished by a combination of: epistome unproduced, gnathopod propods relatively strongly developed, mandibular molar small, right lacinia unevenly bifid, left lacinia 5-dentate, peraeopods 5 & 6, segments 4 & 5 little broadened, uropod 1 peduncle with strong displaced spine, and uropod 3 (female) both rami nearly fully developed and marginally setose. The group includes some of the undescribed forms originally figured by Barnard (1960), including *G. golfensis,* and (despite the unusual form of the left lacinia, and lack of a pronounced displaced spine on uropod 1) also *F. falciformis,* new species.

Foxiphalus falciformis, new species
(Fig. 15)

Material examined:
BRITISH COLUMBIA: Queen Charlotte Islands: Parry Passage, ELB & ELM Stn. H2, August 24, 1957: 1 female ov. (8.0 mm) HOLOTYPE with slide mount, CMN Cat. No. NMCC 1992-0634;1 subadult female (6.0 mm) with slide

Fig. 15. ***Foxiphalus falciformis*** , new species. FEMALE ov. (8.0 mm) HOLOTYPE; MALE penult (6.5 mm) ALLOTYPE. (SEE PAGE 95 - OPPOSITE)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mount, 13 subadult females, 16 immatures, PARATYPES CMN Cat. No. NMCC 1992-0635; Graham I., Masset Harbour, Stn. H14, Aug. 23-27, 1957: 5 specimens, including female br. II (7.0 mm) with slide mount; Yakan Pt., Stn. H14, August 25, 1057; 1 male penult. (6.5 mm) ALLOTYPE, with slide mount, CMN Cat. No. NMCC1992-0636; Ibid: 5 females, 3 males, 2 juveniles, PARATYPES, CNN Cat. No. NMCC1992-0717.

WASHINGTON: Pacific coast, Juan de Fuca Strait, ELB Stns. W22, W24, W34, LW sand, July - August, 1966: 8 females (1 br. III 3 males, penult. San Juan Islands region: off Jamestown, C. P. Staude coll, June 2, 1976: 1 female br II, 1 male subadult (5.5 mm) with slide mount, 1 subadult male, broken.

OREGON: LW sand, ELB Stns. W58, W60, W61, W63 Aug. 13-16, 1966: 52 females, 15 penult. males, 9 imm., including: W63, Cape Kiwanda, Aug. 16, 1966: 1 female, br. II (8.0 mm) with slide mount, male penult. (6.0 mm) with slide mount.

Diagnosis. (Female br. II, 8.0 mm): Pigmented eyes small, subovate. Rostrum medium, broad, subacute apex reaching about mid-point of segment 2 of antenna 1. Antenna 1, flagellum 10-11 segmented, accessory flagellum 6-7 segmented. Antenna 2, peduncular segment 4 with 10-11 strong spines in 3 facial clusters; segment 5 with 6-7 spines in 2 facial clusters.

Mandible, molar very small with 4-6 short marginal blades; raker spines 7-10, short; left lacinia bidentate, outer teeth falciform, centre teeth apparently suppressed; right lacinia deeply bifid, at distal end of raker row; incisor bi- or tri-cuspate; palp segment 3 with cluster of 4-6 medium-long "A" setae. Maxilla 1, outer plate, one lateral apical spine much enlarged, heavy; palp slender, segmental line indistinct. Maxilla 2, inner marginal setae of inner plate long, finely plumulose. Maxilliped outer plate with 1 apical spine, outer plate short, with 8-9 inner marginal masticatory spines.

Coxal plate 1-3 broad, deep, setal clusters confined to hind corner. Coxa 4 broad, deep, rounding posteriorly, upper margins sub-parallel. Gnathopods 1 & 2, carpus, posterior lobe short, with 1 main cluster of setae; propod, length about twice its depth, palms slightly oblique.

Peraeopods 3 & 4, segment 5, postero-distal spine long, tip nearly reaching distal end of segment 6; dactyls medium. Peraeopod 5, basis medium, margins sub-parallel, nearly straight segment 4 expanded, width about 50% greater than length, postero-facial spines lacking; segment 5 deeper than wide, about as long as linear segment 6. Peraeopod 6, basis slightly broadening distally; segment 4 little expanded, length about twice width; segments 5 and 6 linear, hind margins with 4 clusters of single spine and single long, plumulose setae. Peraeopod 7, basis with about 6 indistinct posterior serrations; distal segments sub-linear.

Abdominal side plates 2 & 3, hind margins weakly long-setose; hind corners obtuse, lower margins convex.

Uropod 1, peduncle with 3 baso-facial setae, inner margin with 3-4 slender spines, displaced spine lacking (or very small); rami proximally with 1-2 short posterior spines, apical spines articulating. Uropod 2, peduncle with 5 stout outer marginal spines; outer ramus with 1-2 posterior spines inner ramus bare. Uropod 3, inner ramus more than 2/3 length of outer, both margins distally plumose setose; terminal segment of outer ramus medium-large, with 2 apical plumose setae.

Telson lobes narrowing distally, each with longish dorso-lateral spine, oblique apex with 2 short spines and single setule. Coxal gills large, elongate on peraeopods 2-5, shorter on 6, and short, drop-shaped on peraeopod 7.

Male (penult., 6.0 mm): Rostrum slightly longer than in female, apex reaching nearly to distal end of segment 2, antenna 1. Eye medium-large, ovate. Uropod 3, rami nearly equal, fully plumose-setose.

Mature male: unknown.

Etymology. From the Latin 'falx' (sickle) + 'forma', referring to the sickle-shaped form of the teeth of the left mandibular lacinia mobilis.

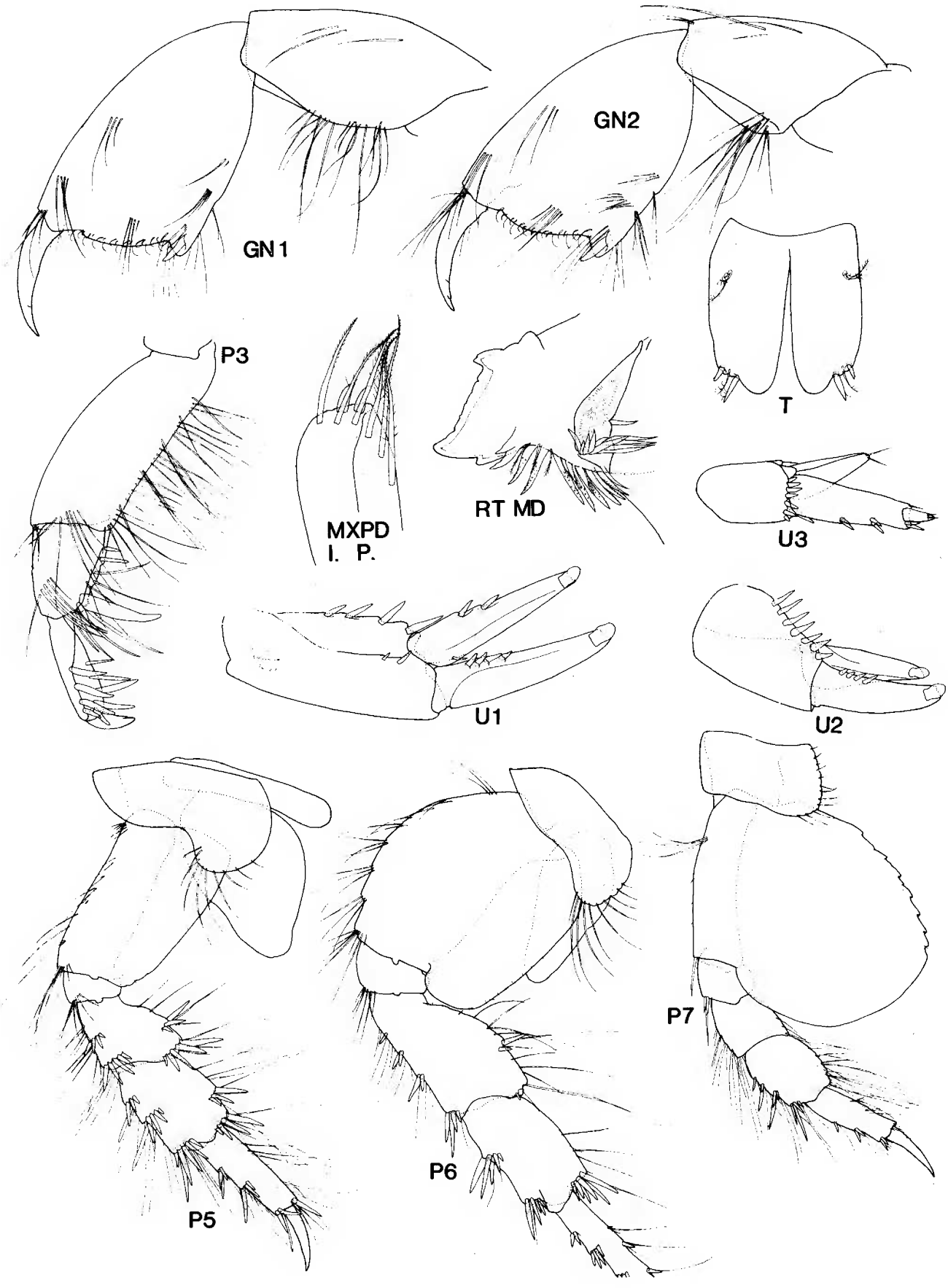
Distribution and Ecology. From the Queen Charlotte Islands south to Central Oregon, in medium fine surf-exposed sands at LW level. The absence of specimens from the Vancouver Island region is an apparent collecting anomaly, not easily comprehended in view of the large number of sandy habitats investigated in that region.

Taxonomic commentary. This species is very close to the generic type species, *F. obtusidens* Alderman, in the fully setose and elongate rami of uropod 3 of the female. *F. falciformis* differs markedly from the type species, however, mainly in the lack of a pronounced displaced spine on uropod 1, the more strongly expanded segments 4 & 5 of peraeopod 3, the less spinose uropods 1 & 2, the shorter, broader rostrum, the more slender dorso-lateral spines of the telson lobes, and the peculiar sickle-shaped form of the outer teeth of the left lacinia mobilis.

Although no mature males were found in the present material, its morphology is presumed similar to that of the mature male of *F. obtusidens* figured by Barnard (1960, pl. 35, S-X) from San Quintin, California, and described in more detail by Barnard and Barnard (1982a, p. 9). In their material, the eyes are very large, nearly meeting mid-dorsally, and the rami of uropod 3 are about equal in length, and fully marginally setose. The 11-segmented flagellum of antenna 1 is calceolate on segments 2-6, and on alternate segments of the elongate flagellum of antenna 2; a single calceolus is located antero-distally on peduncular segment 5 of antenna 2. The copulating spines of peraeopod 7 have apparently not been described.

Fig. 16. ***Foxiphalus aleuti*** Barnard.
FEMALE br. II (9.0 mm)

(SEE PAGE 97 - OPPOSITE)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Foxiphalus aleuti Barnard and Barnard, 1982
(Fig. 16)

Foxiphalus aleuti Barnard & Barnard, 1982: 14, Fig. 1.

Material examined.
ALASKA: Aleutian Islands, Unimak I., subtidal sands, P. Slattery coll., June - October, 1982: 1 female br. II (9.0 mm) with slide mount, fig'd., CMN Cat. No. NMCC1992-0637.

Diagnosis. (Female br. II., 9.0 mm): Rostrum broad, elongate, reaching end of peduncular segment 2 of antenna 1. Accessory flagellum 10-12 segmented, about 60% length of primary flagellum. Antenna 2 weakly ensiform; peduncular segment 5 with a single facial cluster of 3-5 spines.

Epistome unproduced. Mandible, molar with 9-10 marginal blades, and a single displaced blade; spine row with 9-10 rakers and associated setae; right lacinia unequally bifid, offset from the spine row.

Gnathopods 1, carpus slender, hind margin with several clusters of setae; propod little longer than carpus, broadening distally, palmar margin slightly oblique. Gnathopod 2, carpus relatively short, hind lobe sub-acute, with only 2-3 clusters of setae; propod longer than carpus, slightly wider than propod of gnathopod 1.

Peraeopods 3 & 4, segment 5 short, postero-distal spine massive, tip extending 3/4 length of short segment 6; distal marginal spines of segment 6, 4 on each side; dactyl short, stout. Peraeopod 5, basis slightly narrowing distally; segment 4 moderately broadened, width about equal to length; segment 5 distinctly longer than 4 but sub-equal to segment 6; dactyl strong. Peraeopod 6, segments 4 & 5 little expanded, sub-equal in length, in each, width 70-75% of length; segment 6, hind margin with 3 small clusters of single spine and seta; dactyl medium. Peraeopod 7, segment 5 expanded, nearly as wide as long, hind margin strongly setose; dactyl strong.

Uropod 1, peduncular inner margin with 3-4 stout spines, displaced spine stout, length about 1/3 inner ramus, tip reaching beyond single proximal marginal spine of inner ramus; outer ramus with 4 posterior marginal spines. Uropod 2, peduncle with about 7 stout outer marginal spines; outer ramus with 4 closely set posterior spines; both rami with stout embedded apical spines. Uropod 3, both rami short, devoid of lateral marginal setae, inner ramus narrowing, with 2 apical setae; terminal segment distinct, apex minutely setulose.

Telson lobes broad, margins sub-parallel, lacking dorso-lateral spines; apices each with 2 unequal spines and single setule.

Coxal gills on peraeopods 5 & 6 medium, narrowing distally. Mature male unknown.

Distribution and Ecology. From Unalaska, south to Santa Catalina Island, California, in subtidal sands to 110 m. depth.

Taxonomic commentary. This species was only partially figured by Barnard & Barnard (1982a), based on a subadult female from California and a subadult male from Unalaska. The species differs from most other species of *Foxiphalus* in a few plesiomorphic character states (e. g. maxilliped inner plate with 2 apical spines; mandibular right lacinia bifid, offset from spine row). Until more extensive study material becomes available, the species seems best retained as a relatively primitive member of the genus *Foxiphalus*.

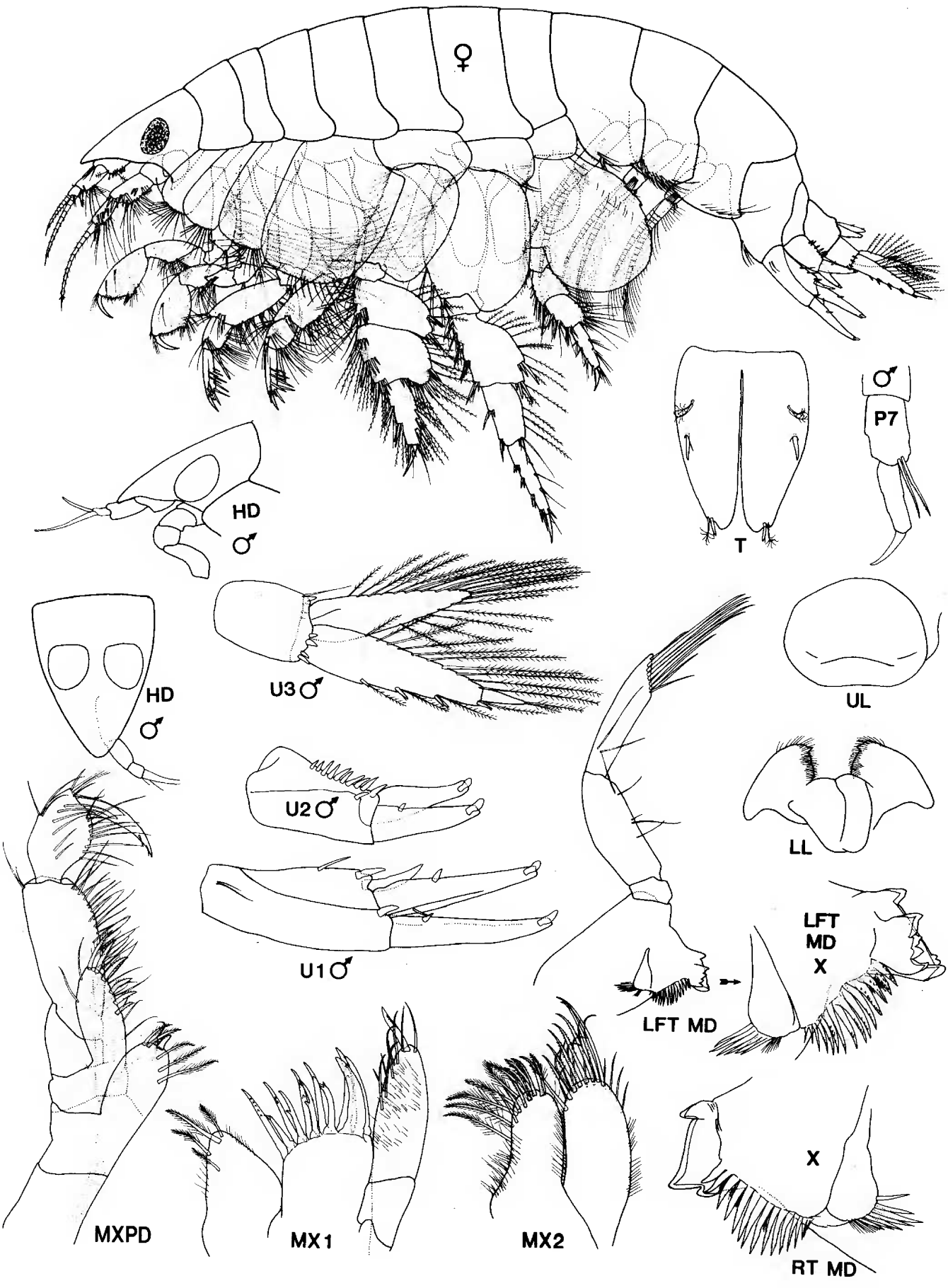
Foxiphalus xiximeus Barnard and Barnard, 1982a
(Fig. 17)

Foxiphalus xiximeus Barnard & Barnard, 1982a: 17, fig. 2.—Bousfield, 1990, fig. 2.—Bousfield, 1991, fig. 3.

Material examined.
ALASKA: Aleutian Islands, Unimak I., P. Slattery coll., (12).
SE Alaska: ELB Stns., 1961: A175 (4) A140 (1); A139 (10); A81(1); A48 (1); A33 (11); A27 (2); A25 (3); A18 (1), A8 (1). ELB stns, 1980 - S1F2 (10); S4B3 (2); S4B5 (l); S8B1 (3); S8B2 (10); S8B1 (3); S8B2 (10); S11B4 (l); S13B3 (1); S18F1 (1000); S18F3 (20); S18F2 (40); S19B2 (1); S19 (B3 (2); S20B4 (3); S22F1 (2).

BRITISH COLUMBIA: Queen Charlotte Islands, ELB Stns., 1957: H2 (96, with slide mounts of 3 females (4.5 - 6.0 mm) and 2 males (5.0 - 5.5 mm); H2b (1); H3 (30); H11 (2); H14 (2).
Central coast: ELB Stns., 1964: HS (l); H8 (25); H26 (8); H30 (1); H35 (8); H43 (50); H44 (10); H50 (30); H57 (4); H59 (10). Swanson Bay, C. Levings coll. (8).
Vancouver Island: ELB Stns, 1955: F1 (5); F3 (250); F4a (25); F5 (1); F6 (50); F9 (53). ELB Stns., 1959: N11 (30); N15 (6); N16 (2); ELB Stns. 1970: P711(1); P716 (100); P717 (80). ELB Stn., 1976: B3: 1 male (3.0 mm) with slide mount); B11: 1 female ov. (7.0 mm) with slide mount); B27 (1). ELB Stns 1964: B5a Metchosin Lagoon: ca. 100 specimens, with slide mounts of 1 female ov. (7.0 mm), fig'd., 1 male (5.0 mm) with slide mount, fig'd., 7 females ov. (4.5 - 6.0 mm), 5 males (3.5 - 5.0 mm) CMN Cat. No. NMCC1992-0638. ELB Stns., 1977 - B5b (6); B5 d. (1); B6 b (1); B8 (2). Pachena Bay, gray whale feeding pits, P. Slattery coll. Pit 1, September 16, 1982: 30 specimens, with slide mount of female ov. (5.0 mm), CMN Cat. No. NMCC1992-0639; April 17,1983: 83 specimens with slide mounts of 1 female ov. (3.8 mm), and 1 male (3.25 mm), CMN Cat. No. NMCC1992-0639. Near Victoria, B. Carl, 1929: (23).

FIG. 17. ***Foxiphalus xiximeus*** Barnard & Barnard FEMALE. ov. (7.0 mm); MALE (5.0 mm).
(SEE PAGE 99 - OPPOSITE)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WASHINGTON & OREGON: ELB Stns., 1966: W22 (22); W24 (6); W26 (1); W33 (2); W34 (20); W44 (1); W45 (4); W50 (25); W53 (1); W57 (1); W58 (500); W60 (25); W61 (3); W63 (40); W64 (25); W66 (20). Juan de Fuca Strait, C. P. Staude, coll., June, 1976: 140 specimens in 41 lots, slide mounts 2 females ov. (4.25, 7.0 mm) and 1 male (4.25 mm).

Diagnosis. (Female ov., 7.0 mm): Pigmented eyes medium, ovate. Rostrum medium, subacute apex reaching midpoint of segment 2, antenna 1. Antenna 1, flagellum 8-9 segmented; accessory flagellum 6-8 segmented. Antenna 2, peduncular segment 4 with 10-11 strong spines in 3 facial clusters; anterior margin usually with 1 cluster of setae and a single spine; segment 5 with about 6 spines in 2 facial clusters, and 1 disto-ventral long spine; flagellum relatively long, 9-11 segmented.

Mandible, molar small with 6-7 marginal blades; spine row long, with about 15 mainly short rakers; left lacinia irregular 4-dentate; right lacinia simple (or lacking?); incisor tricuspate; palp segment 2 weakly setose, inner margin only; segment 3 with small cluster of 3 slender "A" setae. Maxilla 1, outer plate, strong outer spine not exceeding adjacent spines. Maxilliped, inner plate with 1 apical spine; outer plate medium tall, inner margin with 6 masticatory spines.

Coxal plates 1-3 deep, not broad, setal cluster extending more than half way along lower margin. Coxa 4 very large, fore and hind margins sub-parallel. Gnathopods I & 2, carpus medium, slender, hind lobe with 2-3 setal groups: propods medium large, broadening distally (length about 1.7 X maximum width), palms oblique.

Peraeopods 3 & 4, segment 5 not very powerful, postero-distal spine medium, tip reaching about 3/4 length of segment 6; postero-distal spines of segment 6 relatively long, slender; dactyl medium. Peraeopod 5, basis broad, hind margin convex; segment 4 very broad, width nearly twice length (depth), lacking postero-facial spines; segment 5 narrower, width about equal to length, lacking postero-facial spines; linear segment 6 longer than 5, posterior margin plumose-setose; dactyl medium long, slender. Peraeopod 6, basis regular, hind margin early straight; segment 5 moderately expanded, lacking postero-facial spines, length about 50% greater than depth; segment 5 slightly shorter, little expanded, hind margin with a few long plumose setae; segment 6 linear, longer than 5, hind margin with a few clusters of single spine and seta. Peraeopod 7, basis ordinary, hind margin with 4-5 indistinct serrations; segments 4 & 5 little expanded, 5 densely setose behind; segment 6 linear, longer than 5; dactyl slender.

Pleon plate 2, hind corner obtuse, lower margin convex, strongly setose; pleon plate 3, hind corner acuminate, with small cluster of postero-distal long setae. Uropod 1, peduncle with weak baso-facial setal cluster, inner margin with 1-2 slender spines, displaced spine medium-strong, about 1/3 length of inner ramus; rami each with 1 posterior marginal spine, and articulate apical spine; inner ramus with single proximo-medial spine. Uropod 2, peduncle with variable numbers (usually 9-10) of stout inner marginal spines; outer ramus with 1 small proximo-posterior spine. Uropod 3 inner ramus more than 2/3 length of outer, margins distally fully plumose-setose; terminal segment of outer ramus large, with 2 apical plumose setae.

Telson lobes narrowing distally, each with medium dorso-lateral spine; apex with single spine and setule.

Coxal gills large, elongate on peraeopods 2-6, somewhat smaller on peraeopod 7.

Mature male (4.25 mm): Pigmented eyes very large, unevenly subovate, nearly meeting mid-dorsally. Rostrum slightly longer than in female. Antenna 1, proximal 7 segments calceolate. Antenna 2, peduncle segment 5 with single antero-distal calceolus; flagellum elongate, alternate segments calceolate.

Peraeopod 7, copulatory spines slender, nearly straight, distally setulose, subequal, about 80% of length of segment 6.

Uropod 3, rami sub-equal, fully plumose-setose.

Distribution and Ecology. Alaska and SE Alaska to S. California: LW and sub-tidal sands, to depths of about 20 m., along medium surf-exposed and protected beaches. Perhaps the most common and frequently encountered shallow-water metharpiniid species of the North American Pacific region.

Taxonomic commentary. The species is morphologically variable throughout its range, within the same population, and even between left and right sides of the same animal, especially in the spination of the peduncle and rami of uropods 1 & 2. Northern specimens tend to differ from southern types in character states that vary according to size and instar.

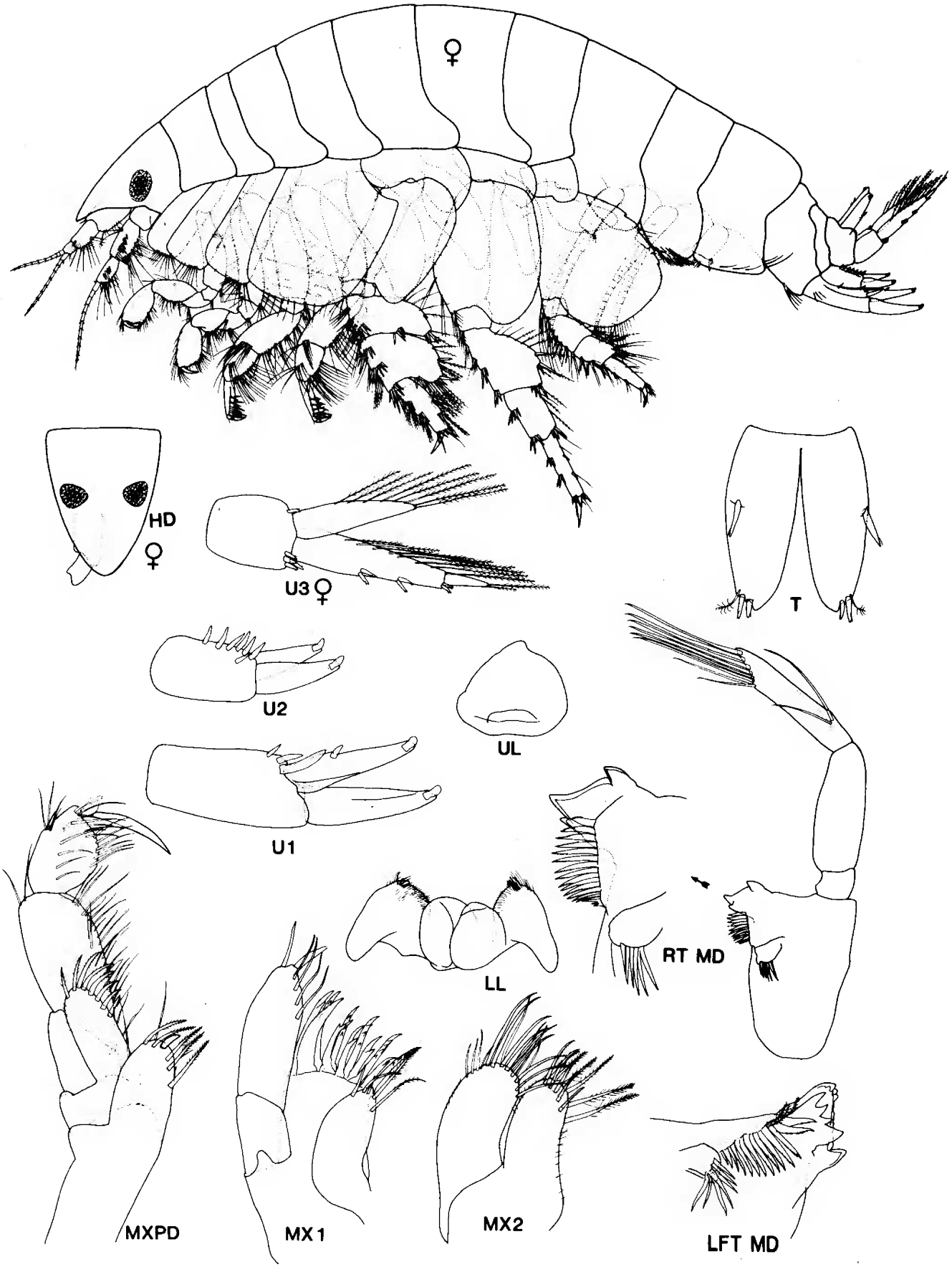
Foxiphalus fucaximeus, new species
(Fig. 18)

Material examined.
WASHINGTON: Neah Bay, LW sand, ELB Stn. W39, July 30, 1966: 1 female ov. (5.5 mm) HOLOTYPE, with slide mount, CMN CAT No. NMCC1922-0641.

Diagnosis. (Female ov. 5.5 mm): Pigmented eyes medium, ovate. Rostrum medium, broad, apex slightly exceeding peduncular segment 1, antenna 1. Antenna 1, flagellum 9-segmented; accessory flagel-lum 9-segmented. Antenna 2, peduncular segment 4 with 6-7 medium strong spines in 3 facial clusters, anterior margin with single cluster of setae and 1 spine; segment 5 with 4-5 spines in single facial cluster; flagellum 10-segmented.

Fig. 18. ***Foxiphalus fucaximeus,*** new species FEMALE ov. (5.5 mm) HOLOTYPE.

(SEE PAGE 101 - OPPOSITE)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Mouthparts very similar to those of *F. xiximeus*. Upper lip, epistome flat, not produced. Mandibular palp segment 2 lacking marginal setae; segment 3 with slightly stronger cluster of 3 "A" setae. Maxilliped, outer plate, and palp segment 2 slightly more robust and more strongly arched than in *F. xiximeus*.

Coxa 1-3 deep, narrow, corners more angular than in *xiximeus*. Gnathopods 1 & 2, carpus and propod relatively slender and longer than in *F. xiximeus;* propod only slightly longer than carpus, little expanded distally.

Peraeopods 3 & 4, segment 6, postero-distal marginal spines relatively short, 5-6 per side; dactyl short.

Peraeopod 5, basis deep, slightly narrowing distally; segment 4 very broad and shallow, with lower facial cluster of 3 spines; segment 5 nearly as broad, wider than deep; segment 6 linear, posterior margin plumose-setose; dactyl short. Peraeopod 6, basis ordinary; segment 4 moderately expanded, nearly as wide as long (deep), hind margin with 2 spines and several singly inserted setae; segment 5 stout, shorter than 4, hind margin with 1-2 isolated setae; segment 6 linear, not elongate, length about equal to segment 4; dactyl medium. Peraeopod 7, basis with 5-6 weak posterior marginal serrations, segment 5 not longer than 4, hind margin strongly setose; segment 6 linear, dactyl short.

Pleon plate 2, hind corner rounded, lower margin convex, strongly setose; pleon plate 3, hind corner slightly bluntly produced, with weak cluster of posterior setae, lower margin about straight, weakly submarginally setose.

Uropod 1, peduncular margins nearly unarmed, 1 basofacial slender spine; displaced spine stout, length more than 1/3 inner ramus, and nearly reaching single posterior marginal spine; outer ramus marginally bare, both rami with articulating apical spines. Uropod 2, peduncular inner margin with 6 stout spines; rami short lacking marginal spines. Uropod 3, inner ramus short, inner margin distally plumose-setose, outer ramus nearly twice length of inner, inner margin strongly setose, terminal segment large, with 2 apical setae.

Telson lobes narrowing distally, each dorso-laterally with stout spine, apices each with 2 short spines and setule.

Coxal gills on peraeopods 2-6 large, elongate, apices subacute, slightly smaller on peraeopod 7.

Mature male: Unknown, but its antennal calceolation is probably very similar to that of *F. xiximeus* described and figured by Barnard (1960).

Etymology. A combining form of "fuca", from the nearby Strait of Juan de Fuca, and *xiximeus*, its nearest species relative.

Distribution and Ecology. Known only from the type locality, Neah Bay, Washington, in medium sand at LW, along with several specimens of *F. xiximeus* and other phoxids.

Taxonomic commentary. Regrettably only a single specimen of this species was found in the material examined. It is most readily distinguished from its close relative, *F. xiximeus,* by the smaller gnathopods, the broadly expanded segments 4 & 5 of peraeopod 5, the shorter inner ramus of uropod 3, and the nearly unarmed rami of uropods 1 & 2.

Foxiphalus similis (Barnard, 1960)
(Fig. 19)

Paraphoxus similis Barnard, 1960: 230, pls. 22, 23.— Barnard & Barnard, 1982a 19, fig. 3.

Material examined:

ALASKA: SE Alaska and Prince William Sound, mainly on surf-protected sand, from LW intertidal to 10 m, ELB Stns., 1961: A7 (3), A3 (1), A33 (1); A37 (1), A30 (7), A8 (7), A98 (1), A117 (1), A161(1), A147 (1), A165 (1), A163 (34 specimens, with slide mount of 1 male (4.0 mm) fig'd., CMN Cat No. NMCC1992-0642. "Super males" were also taken at Stns. A105 (1 "super male:, 1 "super female"); All0 (several "super males", 1 female); A139 (1).

Sitka Region, mostly sub-tidal to 10 m., ELB Stns., 1980: S1F1 (l); S1F2 (4), S17Fl (10), S18F3 (1).

BRITISH COLUMBIA: Queen Charlotte Islands, mostly in fine and silty sands, LW to 10 m., ELB Stns., July-August, 1957: E5 (1); E9 (20); W4a (1); W4b (8); H8b (1); H9 (1); Hll (20); H2 (1 male (3.75 mm) with slide mount); H9 (1 female (4.5 mm) with slide mount).

North central coast: in surf-protected shallow sand, mainly LW to 25 m., ELB Stns., July 1964: H3 (1); H5 (100); Hll (l); HI5 (2); H17 (1); H25 (1, plus 1 "super female"); H29 (1); H30 (30); H39 (1); H47 (30); H50 (10); H53 (70 specimens, with slide mounts of 1 female ov. (3.75 mm), fig'd., 1 sub-adult male (3.2 mm) and 1 male (2.75 mm) CMN Cat. No. NMCC1992-0643; H64 (4). Vancouver Island, North end, ELB Stns., 1959: V3 (1), Vll (1), N22 (2), 013 (1).

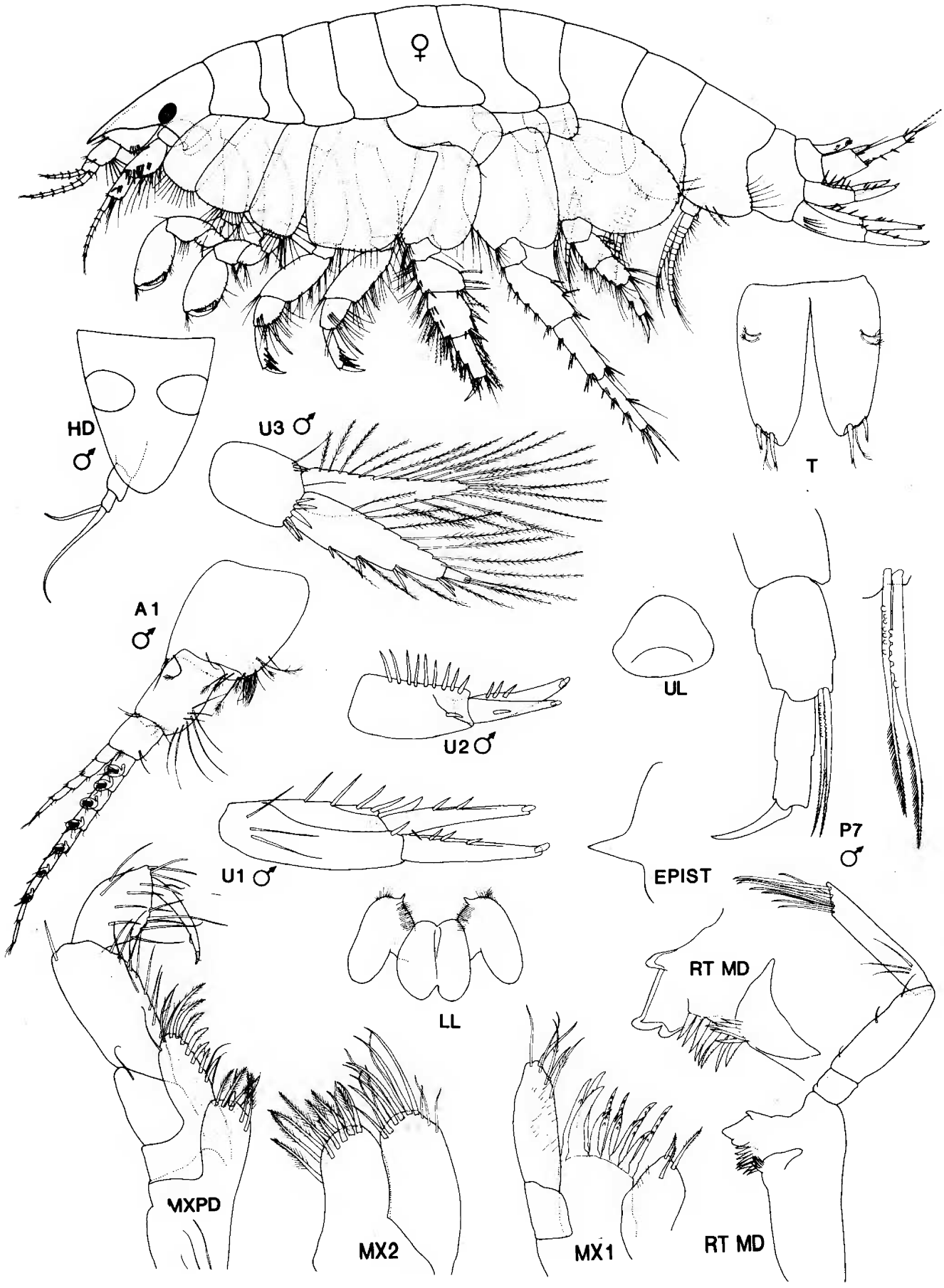
Vancouver Island, South end, LW sand, ELB Stns., 1955: G20 (3), F9 (25); ELB Stns., 1970: P710 (4), P712 (4), P719 (1), P721 (3).

Barkley Sound, LW and sub-tidal sands: Diana I., ELB 2th. P17, August 6,1975: (20); ELB Stns., 1976: B2c (1), Blla (50), Bllb (100+), B27 (2).

Burrard Inlet region, sub-tidal to 15 m. ELB Stns., November 4, 1977: E2 (4); E3 (6).

Other material: J.F.L. Hart coll.: Departure Bay, 1938 (1); 1955 (1); Willows Beach 1941(12); Saturna I., 1955 (20); South Pender I. (15). Quinsam I., E. Black coll., 1981(3). Saanich Inlet, H.E. Conlan coll., January, 1976: ca. 250 specimens in 14 lots, with slide mounts of 1 male (4.0 mm), 1 female ov. (3.75 mm).

Fig. 19. ***Foxiphalus similis*** (Barnard)
FEMALE ov. (4.5 mm); MALE (4.0 mm)
(SEE PAGE 103 - OPPOSITE)


♀
HD ♂
U3 ♂
T
A1 ♂
U2 ♂
UL
P7 ♂
U1 ♂
EPIST
LL
RT MD
MXPD
MX2
MX1
RT MD

WASHINGTON & OREGON: Juan de Fuca Strait: Friday Harbor, ELB Sta. F7, 1955 (10); ELB Stns, 1966, W34 (2), W39 (2), W13 (12). Off San Juan Island, C. P. Staude coll., June, 1976 (ca. 150 specimens, with slide mount of 1 male (3.0 mm), 1 female ov (3.75 mm), 1 female br. II. (3.25 mm). Otter Rock, LW sand, ELB Stn. W60, August 14, 1966: (12).

Diagnosis. (Female ov., 4.5 mm): Pigmented eyes small, oval, near lateral margins. Rostrum normal, rounded apex nearly reaching end of peduncular segment 2 of antenna 1. Antenna 1, peduncular segment 3 not setose posteriorly; flagellum 6-7 segmented; accessory flagellum 5-6 segmented. Antenna 2, segment ensiform; segment 4 with 7-6 medium spines in 3 disto-facial groups, and long postero-distal spine, anterior margin with cluster of spines and a few setae; segment 5 with 3 facial spines and 1 apical spine; flagellum 6-7 segmented.

Mandible, molar small, with about 5 marginal blades; spine row weak, with 8 rakers; right lacinia apparently lacking; left lacinia irregularly 4-dentate; incisor tricuspate; palpar hump distinct; palp segment 2 weakly short-setose anteriorly; segment 3 with weak cluster of 3 "A" setae. Upper lip, epistome strongly produced, acute. Lower lip, outer lobes with strong mandibular wings and distinct shoulder cusps. Maxilla 1, inner plate with 3 apical setae; outer plate outer apical stout spine not exceeding adjacent spines; palp apex setose. Maxilla 2, plates subequal in width. Maxilliped, inner plate with 1 apical spine, outer plate short, with 5 slender masticatory spines; dactyl of palp slender.

Coxa 1-3 large, deep, lower margin of coxa 1 almost entirely setose. Coxa 5 very large, margins converging distally, lower margin straight. Gnathopods 1 & 2 moderately strongly subchelate; gnathopod 2 stronger, carpus, hind lobe short, with 1 setal cluster; propod ovate, broadening distally, twice length of carpus.

Peraeopods 3 & 4, segment 5, postero-distal spine long, tip nearly reaching distal end of segment 6 that is spinose distally only; dactyl strong. Peraeopod 5, basis broad, hind margin convex; segment 4 little expanded, short, width and depth sub-equal, postero-facial spines lacking; segment 5 longer than 4, about equal to linear segment 6 that has a setose posterior margin; dactyl slender. Peraeopod 6, basis ordinary; segment 4 very slightly expended, length slightly greater than sub-equal segments 5 & 6; segment 6 with 1 posterior marginal cluster of spine and seta; dactyl medium long, slender. Peraeopod 7, basis extended posteriorly, hind margin with 7-8 weak serrations; segments 4 & 5 short, weakly setose behind; segment 6 longer, dactyl strong.

Pleon plate 2, hind margin with 2 distal setae; corner obtuse, lower margin convex, setose anteriorly; pleon plate 3 broad, hind margin distally with 6-7 long setae, hind corner obtuse, lower margin with 2 setae.

Urosome 1 lacking ventral setal brush. Uropod 1, peduncle with 3-4 long baso-facial setae, inner margin with 3-4 slender spines, displaced spine stout, extending beyond single spine of inner margin of the inner ramus; outer ramus with 3 posterior marginal spines, both rami with single articulated apical spine. Uropod 2, peduncle with 5-6 outer marginal spines; outer ramus with 2, inner ramus occasionally with 1, posterior marginal spines. Uropod 3, inner ramus very short, about 1/3 length of outer ramus that has plumose setae apically and on prominent terminal segment.

Telson lobes slightly narrowing distally, lacking dorsolateral spines, each oblique apex with 2 slender unequal spines and single setule.

Coxal gills large, sac-like on peraeopods 2-6, moderately large on peraeopod 7 (length = 2/3 length of basis).

Mature male (3.75 mm): Pigmented eyes very large, oval, extending from lower margin nearly to mid-dorsal line. Antenna 1, flagellum 9-segmented, calceolate on proximal segments. Antenna 2, peduncular segment 5 with single antero-distal calceolus; flagellum about 20-segmented, alternate segments calceolate.

Peraeopod 7, copulatory spines very long, straight, nearly equal, proximally denticulate, distally finely setulose, tips extending beyond end of segment 6.

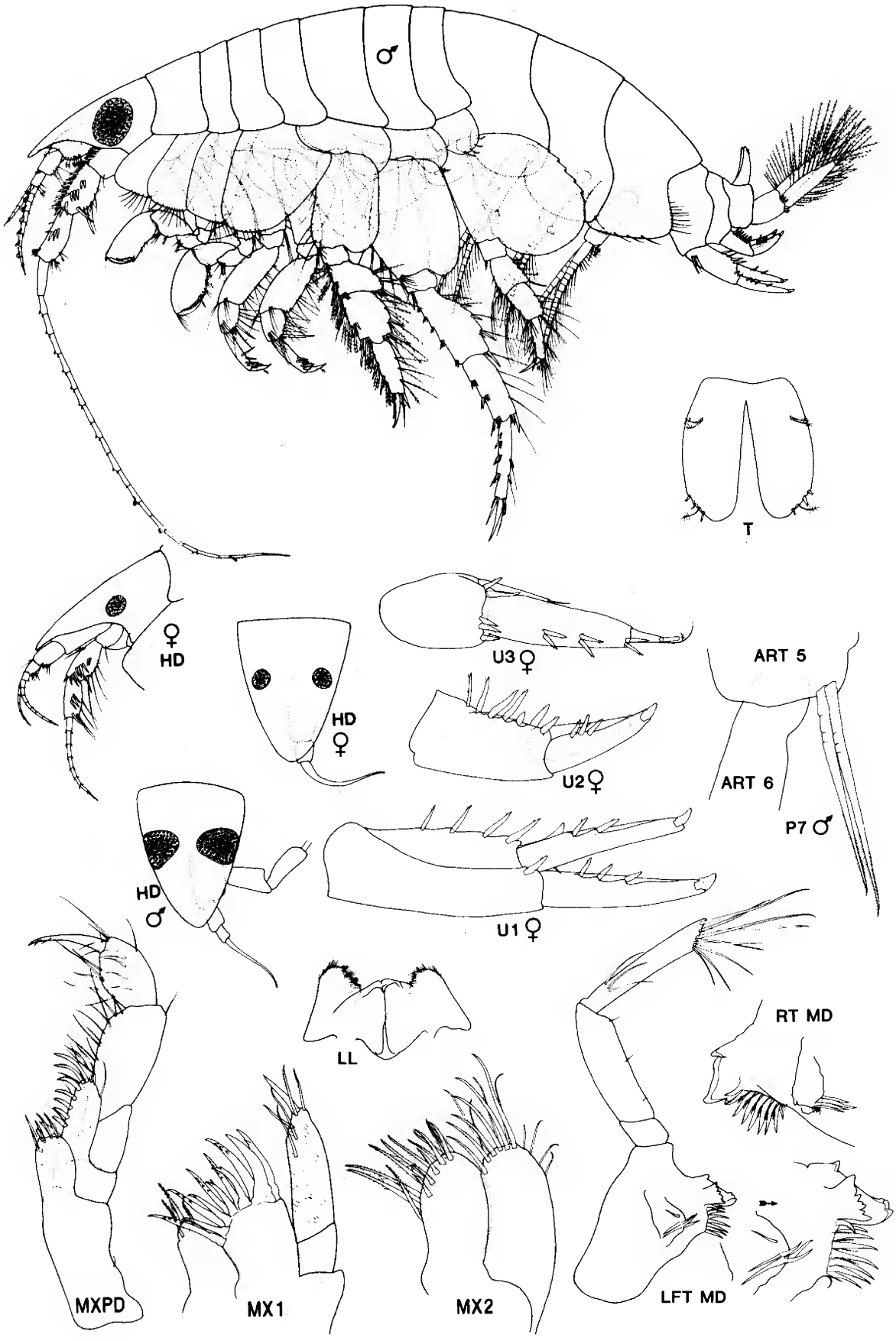
Uropod 2, peduncle with 5-7 marginal spines. Uropod 3, rami lanceolate, inner slightly the shorter, inner margins moderately plumose setose, outer margin with spines and a few setae.

"Super male" (4.0 mm): Several larger males (so-called "super males" of Barnard and Barnard, 1982a) are listed above. They differ only slightly from regular males in having generally more strongly spinose appendages, and 3-4 apical spines on the telson lobes.

Distribution and Ecology. Occurring widely in present collections from Prince William Sound and SE Alaska, southward through British Columbia, Washington State and Oregon, and (in other records) to southern California. It is recorded mainly on surf-protected and finer grained sands, in the north mainly from the lower intertidal level to shallow sub-tidal depths (10-20 m), but at southern localities in depths mainly of 60-100 m, occasionally to more than 300 m.

Taxonomic commentary. This species is the type of the *similis* group, having strongly developed epistomal process, ensiform antennal segment 1, strong uropod 1 displaced spine, inaequiramous uropod 3 (female); and generally weakly spinose peraeopods and uropods. Some of the specimens listed from Unalaska by Barnard and Barnard (1982a) may be referable to *F. slatteryi* or perhaps a third species. The *similis* group appears superficially similar to some members of the Eobrolginae, especially the genus *Eobrolgus* Barnard, in the overall form of the male peraeopods and copulatory spines of peraeopod 7.

Fig. 20. ***Foxiphalus slatteryi***, new species. MALE (4.0 mm) HOLOTYPE; FEM. (5.0 mm) ALLOTYPE. (SEE PAGE 105 - OPPOSITE)


♂
T
♀
HD
HD
♀
U3♀
U2♀
ART 5
ART 6
P7♂
HD
♂
U1♀
LL
RT MD
LFT MD
MXPD
MX1
MX2

Foxiphalus slatteryi, new species
(Fig. 20)

Material examined.
ALASKA: Amchitka I., Constantine Harbor, shallow net haul over sand, C. E. O'Clair coll., October 5, 1968: 1 mature male (5.0 mm) HOLOTYPE, with slide mount, CMN Cat. No. NMCC1992-0644; 19 male PARATYPES, CMN Cat. No. NMCC1992-0645. Constantine Harbor LW sand, P. Slattery coll., Sept. 21,1969:1 female ov.(4.0 mm) ALLOTYPE, with slide mount, CMN Cat. No. NMCC1992-0646; 1 mature male (4.5 mm) with slide mount, 4 mature males, 2 adult females PARATYPES, CMN Cat. No. NMCC1992-0647.

Diagnosis. (Mature male, 5.0 mm): Pigmented eyes very large, broadly ovate, nearly meeting mid-dorsally. Rostrum medium large, subacute apex reaching end of segment 2 of antenna 1. Antenna 1, flagellum 9-segmented, proximal 7 calceolate; accessory flagellum 5-6 segmented. Antenna 2, peduncular segment 4 with 7-8 medium spines in 3 facial clusters, hind margin with strong distal spine; segment 5 with single cluster of 3 facial spines, and single antero-marginal calceolus; flagellum elongate, with about 20 long segments, last 14 alternately calceolate.

Mandible, molar small, with 4-6 marginal blades, and 1 displaced blade; spine row weak, 8-9 short rakers; left lacinia irregularly toothed or flabellate; right lacinia simple (near spine row) or lacking; incisor weakly bicuspate; palp, molar hump distinct; segment 2 lacking marginal setae; segment 3 slender, with cluster of 3 weak "A" setae; apex short, obliquely truncate. Upper lip, epistome with acute process. Lower lip, outer lobes with strong shoulder cusps. Maxilla 1, inner plate with 3 apical setae; outer plate short, outer apical spine little enlarged. Maxilla 2, plates subequal in width. Maxilliped, inner plate with apical spine; outer plate short, inner margin with 7 slender masticatory spines; palp, dactyl very slender.

Coxal plates 1-3 large, deep, distal setae extending along 2/3 of lower margin. Coxa 4, margins strongly converging distally. Gnathopods 1 & 2, carpus relatively short, deep, hind lobe with 1-2 setal clusters; propods subovate, longer than carpus, palms oblique; propod 2 larger than 1.

Peraeopods 3 & 4 not powerfully developed, segment 5 relatively small, postero-distal spine slender, tip reaching 3/4 of segment 6; segment 6 linear, with few (2-3) slender spines on each side; dactyl strong.

Peraeopod 5, basis broad, hind margin very slightly concave; segment 4 little expanded, short; segment 5 nearly twice as long as wide; segment 6 linear, equal in length to segment 5, hind margin with 3 pairs of long plumose setae; dactyl medium long. Peraeopod 6, basis not very broadly expanded, hind margin slightly convex; segments 4 & 5 scarcely at all expanded; segment 4 more than twice as long as wide, hind margin with 4 clusters of spines and plumose seta; segment 5 linear, with 3 posterior marginal setae; segment 6 narrowly linear, equal in length to 5, hind margin with a few clusters of single spine and seta; dactyl long, slender. Peraeopod 7, basis, hind margin with 5-6 weak serrations; segment 4 little expanded, weakly setose behind, pair of copulatory spines nearly straight, setulose tips reach more than halfway along segment 6 that is emarginate proximo-posteriorly; dactyl slender.

Pleon plate 2 broad, margins weakly setose, hind corner obtuse; pleon plate 3 broad, hind margin setose, hind corner rounded, lower margin with 1-2 slender spines. Uropod 1, peduncle with single cluster of baso-facial setae; inner margin with 4 spines, displaced spine strong, tip extending beyond small proximo-medial spine to first of two posterior marginal spines of inner ramus; outer ramus with 3 posterior spines, rami each with articulated apical spine. Uropod 2, peduncle, outer margin with 7-8 stout spines; outer ramus shorter than peduncle, with 3 posterior marginal spines. Uropod 3, rami sharply lanceolate, inner ramus a bit shorter, margins plumose-setose; outer ramus with outer as well as inner marginal setae; terminal segment distinct.

Telson lobes slightly widest medially, lacking dorso-lateral spines, each oblique apex with 3 short spines and a single setule.

Coxal gills large, subovate on peraeopods 2-6, about half the size on peraeopod 7.

Female ov. (4.0 mm): Pigmented eyes medium small, nearly round. Rostrum similar to that of male. Antenna 1, peduncular segment 3 with small cluster of posterior marginal setae; accessory flagellum 5-6 segmented, main flagellum 8-segmented. Antenna 2, peduncle 5 with cluster of 3 facial spines and single long postero-distal spine; flagellum 8-segmented.

Uropod 3, inner ramus short, less than half the length of the outer, margins bare; outer ramus short, little longer than peduncle, margins lacking plumose setae; terminal segment distinct.

Etymology. Named after Dr. Peter Slattery, collector of the species, who has contributed greatly to knowledge of marine invertebrate animals, especially those associated with whale pits, and especially in the Bering Sea region.

Distribution and Ecology. Known only from the type locality at Constantine Harbor, Amchitka I., Alaska, in and above shallow sub-tidal sands.

Taxonomic commentary. *Foxiphalus slatteryi is* a member of the *similis* group having slender, weakly spinose peraeopods, broad pleon plates 2 & 3, parviramous uropod 3 (female), and lacking dorso-lateral telson spines. It differs from *F. similis* mainly in the less extensive setae of the lower margin of coxal plates 1 & 2, the smaller more distally narrowing coxa 4, and shorter apical telson spines.

Rhepoxynius Barnard, 1979

Rhepoxynius Barnard, 1979: 371.—Barnard & Barnard, 1982a: 2 (key).—Barnard & Karaman, 1991: 629.

Type species. *Pontharpinia epistoma Shoemaker*, 1938a, original designation.

N. American-Pacific regional species. *R. fatigans* (Barnard, 1960): 209, pl. 9; *R. daboius* (Barnard, 1960): 210, pls. 10,11; *R. variatus* (Barnard, 1960): 198, pls. 3,4; *R. boreovariatus,* new species; *R. vigitegus* (Barnard, 1971): 74, figs 44-46; *R. bicuspidatus* (Barnard, 1960): 218, pls. 15; *R. barnardi,* new species; *R. tridentatus* (Barnard, 1954): 4, pls 4, 5; *R. pallidus* (Barnard, 1960): 261, pls. 38, 39; *R. lucubrans* (Barnard, 1960): 212, pl. 12; *R. abronius* (Barnard, 1960): 203, pl. 5.

Diagnosis. Body generally short, broad, small in size (6 mm). Rostrum strongly incised in front of eyes, typically distally narrow. Pigmented eyes small in female, large, subquadrate, nearly meeting mid-dorsally in male. Antenna 1, peduncular segment 2 shorter than 1. Antenna 2, segment 1 variously ensiform, segment 4 with 2-3 small groups of antero-facial spines; segment 5 with 0-1 facial groups. In male, calceoli on proximal flagellar setae of antenna l; also on antenna 2: distally on alternate segments of elongate flagellum, and 2 calceoli antero-distally on peduncular segment 5.

Upper lip, epistome variously produced or not. Lower lip broad, shoulders often with weak cones. Mandible: molar small, with few (<10) marginal blades; spine row medium; right lacinia bicuspate rarely simple; left lacinia 4-5 dentate; incisor tricuspate; palp segment 3 shorter than 2, with single cluster of "A" setae, apex obliquely truncate. Maxilla 1, palp short, relatively broad, apically with setae and single spine; inner plate with 3-4 apical setae; outer plate, outer apical spine seldom enlarged. Maxilla 2 inner plate distinctly the smaller. Maxilliped, inner plate, apex rounded, with single apical spine; outer plate short, slender; palp segment 2 variously broadened, dactyl slender, often curved.

Coxal plates 1-4 increasingly deep, 4th broadest, lower margins rounded, setose near hind corner. Gnathopods 1 & 2 slender, carpus longer than weakly subchelate propod, posterior lobes long; propod, little broadening distally, palm vertical, or nearly so.

Peraeopods 3 & 4 medium strong, segment 5 with elongate posters distal spine; segment 6, distal spine(s) slender; dactyl short. Peraeopods 5-7, bases large, broad, dactyls short. Peraeopod 5, basis large, about as deep as in peraeopod 6; segments 4 & 5 expanded, with single postero-facial row of spines; segment 6 stout usually shorter than 5. Peraeopod 6, segment 4 broadened, length greater than width; segment 5 shorter than 6 margins sub-parallel. Peraeopod 7, basis, hind margin often conspicuously toothed; segment 5 variously 'swollen' and setose behind; paired copulatory spines of male (of regional species) sub-equal, slender, straight or slightly curving forwards, denticulate basally, tips often setulose.

Pleon plates 2 & 3, hind corner sub-quadrate or rounded, lower margins strongly setose. Urosome 1, rarely with ventral brush of setae. Uropod 1, peduncle often with baso-facial setal cluster, lacking distal displaced spine (in all regional species except *R. lucubrans),* margins usually sparsely spinose; rami unequal, shorter than peduncle, sparsely spinose posteriorly. Uropod 2, peduncle variously with stout outer marginal spines; rami unequal, posteriorly with few (or no) short spines. Uropod 3 of female short, inaequiramous, inner ramus with few (or no) marginal setae terminal segment conspicuous, apex bisetose; of male large, aequiramous, margins plumose-setose; terminal segment small.

Telson lobes long, straight, lacking dorso-lateral spine(s); each usually with 2 to several long, very slender apical spines and setule.

Coxal gills large, elongate on peraeopods 2-6, small on peraeopod 7.

Taxonomic commentary. Several other species of North American Pacific species of *Rhepoxynius* occur from southern California to Baja California but are not expected to be found in the present northerly study region (Table XII). These southern species are variously described, figured, and keyed in Barnard (1960), and Barnard and Barnard (1982b) and include: *Rhepoxinius menziesi*, *R. stenodes, R. gemmatus, R. homocuspidatus,* and *R. heterocuspidatus.* The last four species lack a displaced spine on uropod 1, and the last three possess small, stout 'rhombic' or jewel-like spines on the rami and peduncle of uropods 1 & 2.

Species of *Rhepoxynius* of the N. American Atlantic coast *(R. epistomus* Shoemaker 1936, *R. hudsoni* Barnard & Barnard, 1982b, and various figured but unnamed species) tend to exhibit plesiomorphic character states such as heavily spinose uropods, often with displaced spine; ventrally setose urosome l; 2 apical spines on the inner plate of the maxilliped; and three or more calceoli on peduncle 5 of antenna 2. In the very closely related genus *Microphoxus* (Pacific Costa Rica, and Magellanica), the rostrum is short, the mandibular incisor is 'molarized', segment 4 of peraeopod 6 narrows distally, and urosome 3 bears a stout forward-curving sabre-like process. In the tropical genus *Metharpinia* (e. g. *M. floridana* (Shoemaker, 1933), *M. oripacifica* Barnard, 1980a), the rostrum is constricted and reduced, antennae 2 is not ensiform, and sub-apical spines or nails occur on one ramus of uropods 1 & 2.

Distributional Commentary. The biogeographical affinities of the genus *Rhepoxynius* are apparently southern and warm temperate-tropical. Component species do not occur outside the North American coastal marine region. On the Pacific coast, the genus reaches its northern limit along the north-central coast of British Columbia, including the

Key to North Pacific species of *Rhepoxynius*

1. Pleon plate 3, hind corner sub-quadrate; uropod 3 (female), inner ramus more than half length of outer ramus, margins with a few setae; telson apical spine(s) short, thick. . . . . 2.

---Pleon plate 3 rounded behind and below; uropod 3 (female), inner ramus very short, margins lacking setae; telson, spical spines long, slender . . . . . 3.

2. Uropod 1, peduncle lacking displaced spine; peraeopod 7, hind margin of basis with 7-10 low serrations epistome strongly produced; gnathopod 2, carpus elongate; uropod 1, outer ramus with 4-5 marginal spines . . . . . ***R. abronius*** (p. 109)

---Uropod 1, peduncle with stout displaced spine; Peraeopod 7 hind margin with 3-4 stout teeth; epistome not, or weakly produced; gnathopod 2, carpus shortened & deepened; uropod 1, outer ramus with 1-3 posterior marginal spines . . . . . ***R. lucubrans***

3. Peraeopod 5, basis with proximal post process; urosome 1 with forward-curving mid-dorsal process; uropod 1, rami markedly unequal; epistome with upwardly curving process . . . . . ***R. vigitegus*** (p.116)

---Peraeopod 5, basis rounded behind; urosome 1 smooth above; epistomal process straight . . . . . 4.

4. Peraeopod 7, hind margin of basis with 3-5 prominent teeth; uropod 2, peduncle with numerous (3+) inner marginal spines . . . . . 5.

---Peraeopod 7, hind margin of basis with 2 spikes, or with 3-5 unremarkable serrations; uropod 2, peduncle with few (1-4) marginal spines . . . . . 6.

5. Uropod 2, peduncle, outer margin with 4-5 stout rhombic spines, telson with short apical spines . . . . . ***R. pallidus*** (p. 112)
---Uropod 2, peduncle, outer margin with 2-3 unequal spines; telson apices each with pair of long setae . . . . . ***R. tridentatus*** (p. 110)

6. Peraeopod 7, basis with 2 stout posterior margin teeth or processes . . . . . 7.

---Peraeopod 7, basis with 3-5 teeth, not prominent . . . . . 8.

7. Telson, apical spines slender, long; gnathopod propods, broadened distally, palms oblique; peraoepod 7, basis, upper 'spur' of hind margin not larger than lower spur; segment 5 'swollen', setose behind . . . . . ***R. barnardi*** (p. 120)

---Telson, apical short; gnathopod propods weak, slender, palms vertical; peraeopod 7, basis, upper spur of upper spur of hind margin distinctly larger than lower spur; segment 5 regular ***R. bicuspidatus*** (p. 118)

8. Epistome weakly produced, length not greater than basal width; peraeopod 5, segment 4 strongly broadened; pleon plate 3, lower margin short, not overlapped by pleon 2 (in normal position) . . . . . 9.

---Epistome strongly produced; peraeopod 5, segment 4 little wider than long (deep); pleon plate with with slightly indented hind margin pleon 3, lower margin long, overlapped by pleon 2 . . . . . 10.

9. Rostrum narrow, apex subacute; peraeopod 7, basis regularly rounded behind; telson lobes each with 5-6 long slender spines . . . . . ***R. fatigans*** (p. 122)

---Rostrum medium broad, apex rounded; peraeopod 7, basis, postero-distal margin nearly straight; telson lobes each with 1 long, slender spine (and a few short setae) . . . . . ***R. daboius*** (p. 122)

10. Peraeopod 7, basis, hind margin with 3-4 strong, sub-equal teeth; uropod rami lacking posterior spines; peraeopod 5, segment 4 distinctly broader than deep ..... ***R. variatus*** (p. 116)

----Peraeopod 7, basis, hind margin with 4-5 normal teeth, increasing in size distally; peraeopod 5, segment 4 little broader than deep; uropods 1 & 2, one or both rami with single posterior marginal spine ..... ***R. boreovariatus*** (p. 114)

Queen Charlotte Islands, and on the Atlantic coast, in the Cape Cod region (Barnard & Barnard, 1982b). No species of *Rhepoxynius* have yet been recorded from the coasts of eastern Asia, or elsewhere in the western Pacific region.

Rhepoxynius abronius (Barnard, 1960)
(Fig. 21)

Paraphoxus abronius Barnard, 1960: 203, Pl. 5.
Rhepoxynius abronius: Barnard & Barnard, 1982a: 26.—Bousfield, 1990: 13.—1991: 84.

Material examined:
BRITISH COLUMBIA:Queen Charlotte Islands, ELB Stns., 1957: E14c (26 specimens with slide mounts of 2 females ov. (4.5, 5.5 mm) and 1 male (4.5 mm); H2 (4 specimens with slide mount of 1 imm. female (4.0 mm) and 1 male (4.0 mm); H3 (2 specimens).
Central Coast: ELB Stns., July-August, 1964: H8 (11); H10 (30 specimens, with slide mounts of 1 female br. II (5.5 mm), fig'd., 1 mature male (5.0 mm), fig'd., and 2 males (4.0, 4.5 mm) CMN Cat. No. NMCC1992-0648; H13 (30); H23 (1); H37 (1); H49 (1).
Vancouver I.: ELB Stns., 1959: V7 (20); 07b (4), 07d (1); 013 (25); ELB Stn., 1964: H4I (l); ELB Stns. 1970: P711 (10); P703 (ca. 100 juv.); ELB Stns. 1975: P29b (2); P22 (9); P21a (7); P21b (2). ELB Sths., 1976: B4 (1); 9c (2); B9e (6). ELB Stns., 1977: B8 (2) ELB Stn., 1955: Fl (1).
French Creek, Penny O'Rourke coll., August 23, 1977: 3 specimens, with slide mount of 1 female ov. (5.0 mm).
Pachena Bay, gray whale feeding pits, P. Slattery coll., Pit 1, September 16,1982: 9 females, 11 subadult males, with slide mounts of 1 imm. male (3.75 mm) and 1 male (4.25 mm).

WASHINGTON: ELB Stns., 1966: W31(2); W33 (40); W39 (2).
Juan de Fuca Strait, C. P. Staude Stns., June 3, 1976, 76 specimens; Twin R., June 14,1976: mature male (4.25 mm) (slide mount) and a series of slide mounts prepared by C. P. Staude.

Taxonomic commentary. The material from the present northern study region is generally larger in size, and exhibits heavier armature of the appendages, than Barnard's original material from southern California (loc. cit). However, the smaller southern material shows somewhat more strongly developed gnathopod propods. The northern material also exhibits some degree of morphological variability attributable to both meristic growth, and to local population factors, but nothing that merits serious consideration of further species subdivision and recognition. As the species is proving useful in bioassay testing of toxic waste materials in north-eastern Pacific bottom sediments (e. g. Bousfield, 1990, in McLeay Associates, Rpt, 1991, Swartz, 1989-90), a full description is provided below in order to assist in reliable identification of the species in this region.

Diagnosis. (Mature male, 5.0 mm): Pigmented eyes very large, sub-quadrate, nearly meeting mid-dorsally. Rostrum short, narrow, subacute apex reaching little beyond peduncular segment 1 of antenna 1. Antenna 1, flagellum short, 8-segmented, proximal 5 calceolate; accessory flagellum 7-segmented. Antenna 2, segment 1 strongly ensiform; segment 2 gland cone distinct; segment 4 with 2 small clusters of facial spines and single posterior marginal spine; segment 5 with 1 small cluster of facial spines, and 2 antero-distal marginal calcoli; flagellar segments about 40-45 in number, individually short, distally alternately calceolate.

Epistome acutely produced. Lower lip, shoulders with small cones. Mandible: molar small, with 5-7 blades; spine row medium with 9-11 rakers, and associated setae; left lacinia flabellate, right lacinia broadly and unequally bifid; incisor narrow, tricuspate; palp segment 2 arched distally, lacking facial cluster of setae; segment 3 with cluster of 3 unequal "A" setae. Maxilla 1, palp short, broad, obliquely truncate apex not reaching tips of apical spines of outer plate. Maxilla 2, plates tall, inner plate narrow; outer plate, outer margin strongly setulose. Maxilliped, inner plate apically rounded; outer plate with 7-8 slender masticatory spines; palp strong, segment 2 medium strong; dactyl strong, nearly straight.

Coxae 1-3 medium, increasing in depth posteriorly. Coxa 4 nearly as broad as deep, smoothly rounded below, hind process acute. Gnathopods 1 & 2, propods slender, little broadening distally, palms nearly vertical.

Peraeopods 3 & 4 medium strong, segment 5 not narrowed, postero-distal spine not reaching end of segment 6; segment 6, posterior spines longer than dactyl, confined to distal half of segment. Peraeopod 5, basis slightly broadening distally; segment 4 very broad, width 50% greater than depth (length), posterior facial spine row strong; segment 5 deeper, narrowing distally; segment 6 strong, longer than 5; dactyl long. Peraeopod 6, basis broadest distally; segment 4 about twice as long as wide; segment 5 much shorter, margins sub-parallel; segment 6 linear, about as long as

segment 4; dactyl slender. Peraeopod 7, basis sub-circular, hind margin with 8-10 weak teeth; segment 6 elongate, not swollen; copulating spines about half length of segment 6, sub-equal, nearly straight, proximal 2/3 denticulate; dactyl slender.

Pleon plate 2, hind corner obtuse, lower margin convex, with vertical sub-marginal fan of plumose setae; pleon plate 3, hind corner acuminate, lower margin convex, strongly setose. Urosome 1 with ventral cluster of setae. Uropods 1 & 2 relatively long and slender; uropod 1, peduncle with 1-2 baso-facial setae; inner margin with 7-8, outer margin with 4 medium spines, lacking displaced spine; outer ramus with 4-5, inner ramus with 2, posterior marginal spines. Uropod 2, peduncle, outer margin with 6-8 tall spines; outer ramus with 3-4, inner ramus with 2, posterior marginal spines. Uropod 3, rami long, lanceolate, sub-equal, margins richly plumose-setose; terminal segment distinct.

Telson, lobes slender, long, apices each with 2 unequal spines.

Coxal gills on peraeopods 2-5 medium broad, apices rounded, slightly smaller on peraeopod 6, short, drop-shaped on peraeopod 7.

Female br II (5.5 mm): Rostrum similar to that of male. Pigmented eyes small, ovate. Antenna 2, peduncular segment 4 with 3, segment 5 with 2, clusters of facial spines. Uropod 3, inner ramus narrow, with a few apical and subapical plumose setae, about equal in length to proximal segment of outer ramus; outer ramus with 3-4 plumose setae along distal margins; terminal segment distinct apex with 2 plumose setae.

Distribution and Ecology. Queen Charlotte Islands and north central coast of British Columbia, southward through Washington and Oregon to California. The species occurs commonly and abundantly inshore and sub-tidally, mostly at surf-protected localities, in sand, variously to depths of 10-15 metres. Records below 50 m. depth may refer to other, yet undescribed, species.

Taxonomic commentary. Considerable morphological variability is evident throughout the geographical range of this species. Specimens from H10 (Oval Bay) are larger (5.0 mm) than those from California described by Barnard & Barnard (c. 3 mm). In specimens from the N. central B. C. coast, the epistomal cusp is less elongate, and the telson lobes each bear 1 (not 2) apical spines. Antenna 2 is strongly ensiform in B. C. specimens. The pattern of spines on peduncle and rami of uropods 1 & 2 also varies in size and number.

R. abronius demonstrates mostly plesiomorphic character states and, as cluster analysis demonstrates (p. 125), it is isolated rather widely from other species of the genus. This situation appears similar to that of the ultra-primitive species, *G. grandis,* within the genus *Grandifoxus.* Remarkably, such primitive species are the most intertidal, the most widespread, and most commonly encountered regional species within their respective genera. However, both species appear to be 'generalists' and tolerate a relatively wide range of substrate types, salinities, and year- round temperatures. These features lend themselves to use as relatively lab-hardy experimental animals, and value as indicator species of marine environmental conditions.

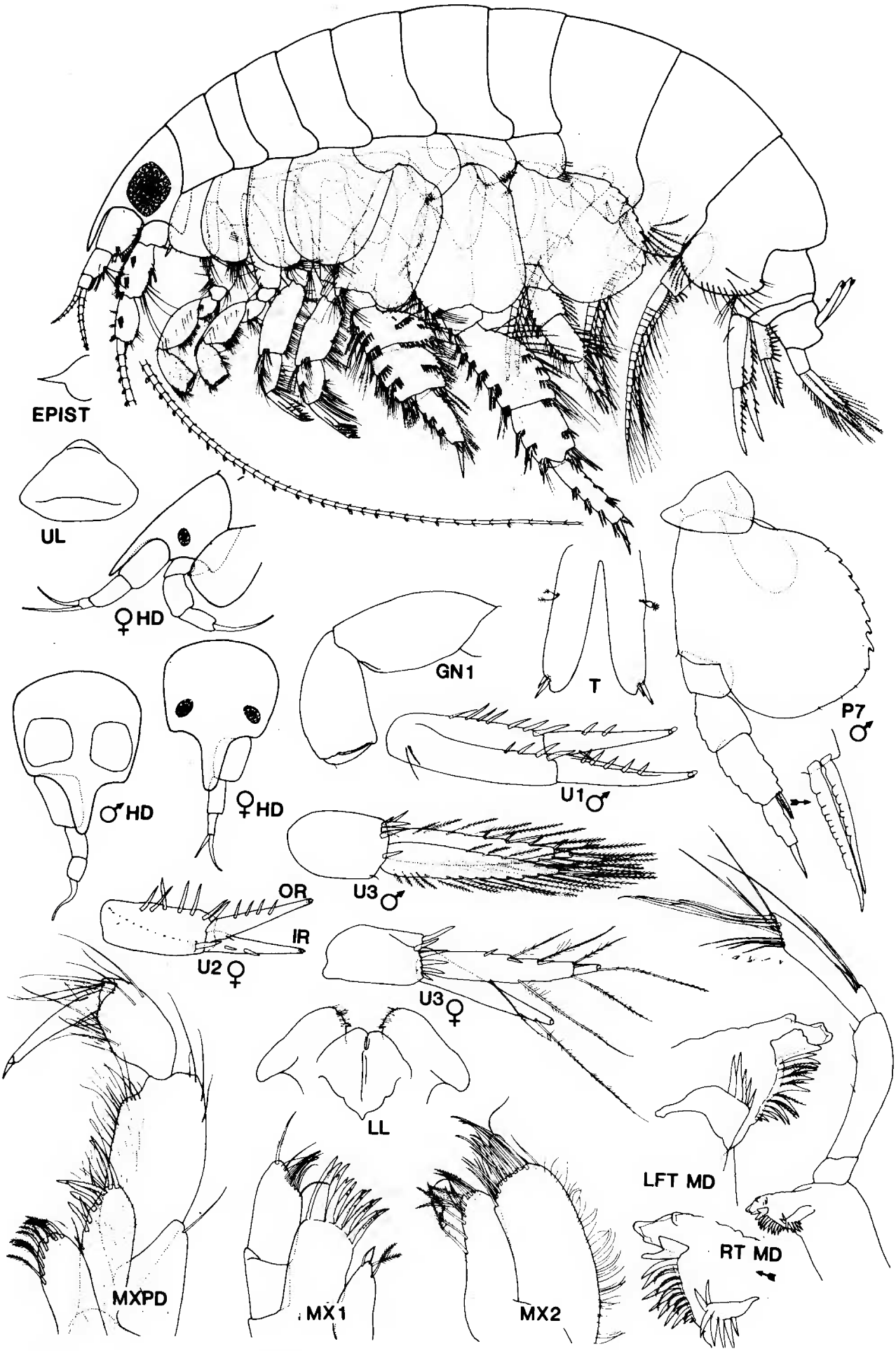
Rhepoxynius tridentatus (Barnard 1954)

Pontharpinia tridentata Barnard, 1954: 4, pls. 4, 5.
Rhepoxynius tridentatus: Barnard & Barnard, 1982a: 42 (part) non Fig. 6b.
non: *Paraphoxus tridentatus pallidus Barnard, 1960:* 261, pls. 38, 39.
non: *Paraphoxus heterocuspidatus Barnard, 1960:* 224, pls. 19, 20.

Taxonomic commentary. Material ascribable to Barnard's original type species from Oregon was not found in present collections. Barnard (1960) established the subspecies *R. tridentatus pallidus* on the basis of material from the San Juan Islands and Puget Sound region. He also included, within the *tridentatus* group, his (then) new species *R. heterocuspidatus* from S. California, and postulated that differences in the strength of the gnathopods was probably attributable to ecophenotypic variation. Barnard and Barnard (1982a), in essence, considered *R. tridentatus* to represent a clinal series of forms from *pallidus* in the north to *heterocuspidatus* in the south. Doubtless these three morphotypes are closely similar in several, mainly apomorphic character states such as: short, broad rostrum; large antennal gland cone; unproduced epistome; small mandibular molar and short spine row; stout maxilliped palp with weakly falcate dactyl; small coxal plates 1-4; tridentate P7 basal margin, and generally short uropods with rhombic spine on uropod rami. However, in our view, the differences between these forms are significant in both quantity and quality, and at the same levels that separate other closely related species within the genus (e. g., *R. fatigans and R. daboius; R. bicuspidatus, and R. barnardi;* and *R. variatus* and *R. boreovariatus.* These species level differences are recognized in the key to species (p. 108) and in the detailed descriptive accounts elsewhere (*R. pallidus,* p. 112).

Distribution and Ecology: Authentic material of this species has to date been recorded only from the coast of Oregon, on fine sand, in 40-80 m. depth.

Fig. 21. ***Rhepoxynius abronius*** Barnard.
MALE (5.0 mm); FEMALE br II (5.5 mm).
(SEE PAGE 111 - OPPOSITE)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♂HD
♀HD
GN1
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U1♂
P7♂
U3♂
OR
IR
U2♀
U3♀
LL
MXPD
MX1
MX2
LFT MD
RT MD

Rhepoxynius pallidus (Barnard, 1960)
(Fig. 22)

Paraphoxus tridentatus pallidus Barnard, 1960: 261, pls. 38, 39.
Rhepoxynius tridentatus Barnard and Barnard, 1982a: 42 (most), fig. 6.
non *Rhepoxynius heterocuspidatus* (Barnard, 1960): 224, pls. 19, 20.

Material examined.
BRITISH COLUMBIA: North central coast, mostly LW to 7 m., ELB Stns., July, 1964: H2, Kiusta village: 4 specimens, with slide mount of 1 female br. II (4.5 mm); H13, Lelu I.: 1 male penult. (6.0 mm) with slide mount, fig.'d, CMN Cat. No. NMCC1992-0649; H25, Cox Pt.: 5 specimens, with slide mount of 1 female ov. (4.6 mm), fig'd., CMN Cat. No. NMCC1992-0701.
Southern Vancouver Island: Victoria, Trial Island Pt., LW to sub-tidal sand and fine gravel, ELB Stn. B6c, May 18, 1977 (2); Haro Strait, D. V. Ellis Sta. 2403, March 8,1979 (1). Saanich Inlet, K. E. Conlan Stns., 1975-1976: 22 specimens in 10 lots.

Diagnosis. (Male, penult (6.0 mm): Body broad, dorso-ventrally depressed and broadened. Pigmented eyes large, nearly meeting mid-dorsally. Rostrum short, broad, apex sub-acute, reaching middle of peduncular segment 2, antenna 1. Antenna 1, peduncle 1 short, deep, not longer than slender segment 2; flagellum 10-segmented; accessory flagellum 7-segmented. Antenna 2, segment 2, gland cone prominent; segment 4 with 3 facial groups of spines (3-4 per cluster); segment 5 with single facial group of 2 spines; flagellum with about 27 short segments, conjoint proximally.

Epistome not produced. Lower lip with shoulder cones. Mandible: molar small, with 4-5 blades; spine row short, with 7-8 weak rakkers; right lacinia bifid; left lacinia broad, 5-dentate; incisor broad, bi- or tri-cuspate; palp short, segments heavy, segment 3 with cluster of 3 unequal "A" setae. Maxilla 1, palp broadening distally, apex nearly reaching tips of outer plate spines, outermost of which is strongly developed. Maxilla 2, outer plate, outer margin finely setulose. Maxilliped, inner plate not short, apex rounded; outer plate with 6-7 inner marginal masticatory spines; palp large, segment 2 broad, dactyl heavy, little arched.

Coxal plates 1-4 medium, increasing posteriorly. Coxa 4, margins converging slightly distally, lower margin gently convex; hind process rounded. Gnathopods 1 & 2 slender; carpus long, slender, propod narrow proximally, deepening (widening) distally, palm vertical. Peraeopods 3 & 4 medium strong, segment 5 short, postero-distal spine not reaching end of segment 6; posterior spines along distal half of segment 6, spines longer than dactyl. Peraeopod 5, basis broad, margins slightly diverging distally, hind margin nearly straight; segment 4 about 30% broader than deep; segment 5 sub-quadrate, nearly as broad as 4 but slightly deeper, margins convex, postero-facial spines stout, not slender; segment 6 shorter, hind margin with 2-3 setal groups; dactyl medium. Peraeopod 6, basis broadening distally; segment 4, moderately broad, length 50% greater than width; segment 5 much shorter than linear segment 6; dactyl short. Peraeopod 7, basis directed distally rather than posteriorly, hind margin with 3-4, sub-equal prominent teeth, distal margin slightly convex; segment 5 slightly swollen, slightly longer than 4, hind margin with 4-5 setal clusters; dactyl medium, curved, about half length of slender segment 6 (not thick, long and straight as in *R. tridentatus*).

Pleon plate 2 narrow, evenly rounding and heavily setose below. Pleon plate 3, hind corner broadly obtuse, or with slight angle, with 5-6 lower marginal setae. Uropods 1 & 2 short. Uropod 1, peduncle with baso-facial cluster of 3 setae; inner margin with 3 spines, heavier distally; rami each with single posterior marginal short spine. Uropod 2, peduncle with 4-5 outer marginal stout 'rhombic' spines, heavi-est at distal angle; outer ramus lacking, inner ramus with single, short posterior marginal spine. Uropod 3, rami sub-equal, broadly elongate, inner margins distally short setose; terminal segment distinct, apically bisetose.

Telson lobes with single, short, thin, apical spine and setule.

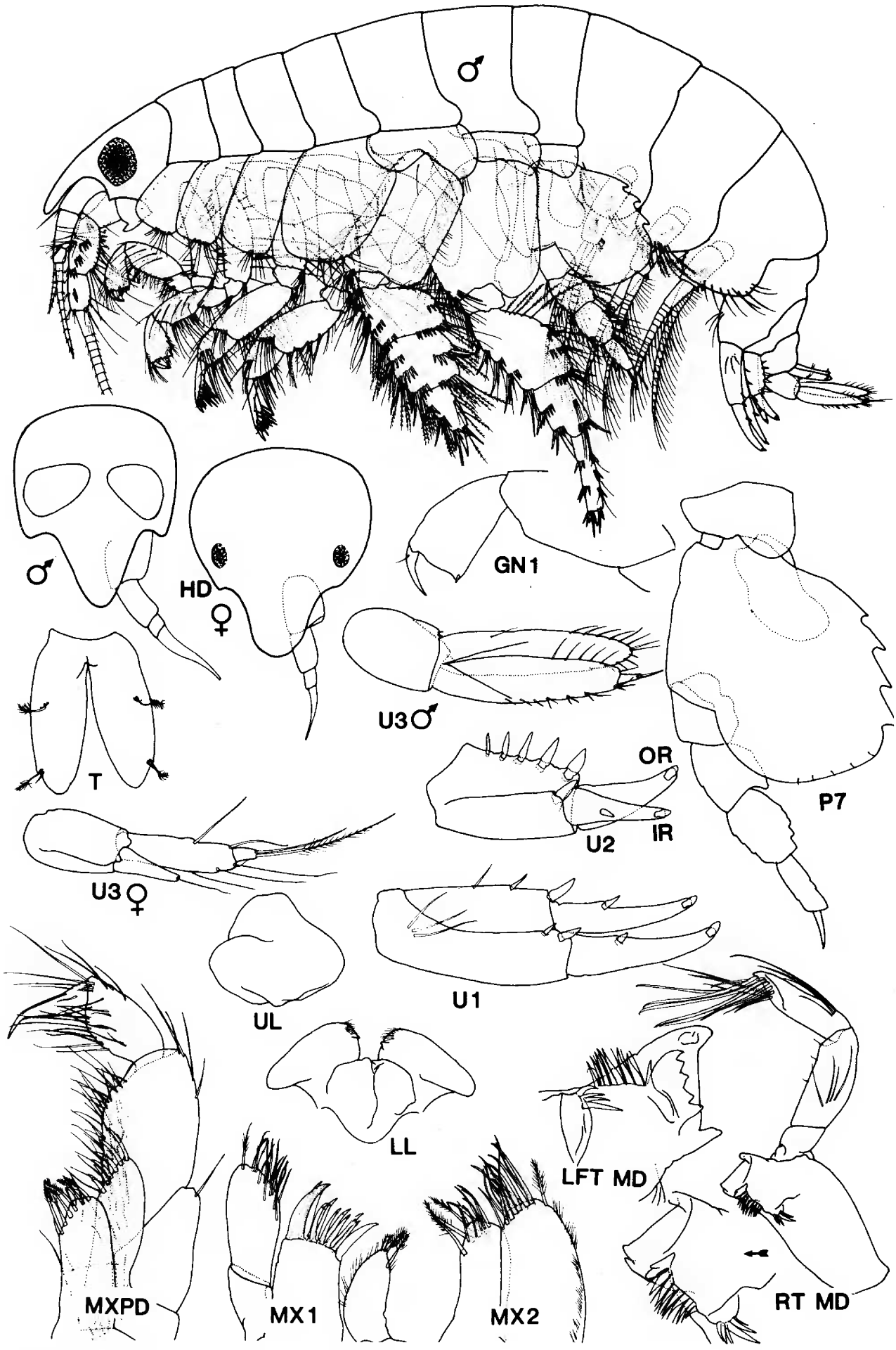
Coxal gills medium broad, elongate, spade-shaped on peraeopods 2-5, slightly smaller, leaf-like on peraeopod 6, small, drop-shaped on peraeopod 7.

Female ov. (4.5 mm): Pigmented eyes small, oval, lateral. Rostrum slightly shorter, apex more broadly rounded than in penultimate male. Uropod 3, inner ramus tall conical, about half length of outer ramus, apex with single long seta; outer ramus sub-linear, margins distally with 2-3 setae and accessory spines (outer); terminal segment stout, with 2 long apical setae.

Taxonomic commentary. *Rhepoxynius pallidus is* unquestionably closely related to *R. tridentatus,* but differs consistently in characters of the key (p.108) and the following: rostrum distinctly broader and longer; antenna 2, segment 5 with 2-3 facial spine (vs. 0); mandibular spine row longer, rakers more numerous (7-8 vs 4-6); gnathopods 1 & 2, propod palms vertical, vs. slightly oblique; peraeopods 3 & 4, segment 6, posterior spines elongate, extending along distal half of segment 6 (vs. sub-apical only); peraeopod 5, segments 4 & 5 broader and shorter, poster-facial spines stronger; peraeopod 7, dactyl slender and curved (vs. thick and straight); uropod 2, outer margin with 4-5 outer marginal (rhombic) spines (vs 2 spines); uropod 3 (female), inner ramus long-conical (vs short-conical); telson lobes with single short spine (vs 2 long setae).

The *R. tridentatus* group displays a number of plesiomorphic traits that places it well below the most

Fig. 22. ***Rhepoxynius pallidus*** (Barnard)
MALE penult (6.0 mm); FEMALE ov. (4.5 mm)
(SEE PAGE 113 - OPPOSITE)


♂
♂
HD
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U3♂
T
OR
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P7
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UL
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MXPD
MX1
MX2
RT MD

advanced species groups within the genus. The group is not very closely related to any other regional species complex, but in balance may be least remote from the *bicuspidatus* group (see phenogram, p. 127).

Distribution and Ecology. Known only from coastal waters of British Columbia, from the North central region to the Strait of Juan de Fuca, and Puget Sound; from LW and immediate sub-tidal sands to muddy sands at more than 40 m. in depth.

Rhepoxynius boreovariatus, new species
(Fig. 23)

? Rhepoxynius variatus Barnard, 1960: 19, fig. 4.

Material examined.
BRITISH COLUMBIA: North Central Coast: ELB Stns. 1964: H13, Lelu I: (2 females); H17, off Kennedy I: 8 specimens, with slide mount of male (3.5 mm).
Vancouver Island: North end: Oyster Bay, ELB Sta., June 21,1959: V22 (1); Barkley Sound: ELB Stns., July 29,1975: P13 (2). ELB Stns., June July, 1976: B9e (9); B10a, b, (5), B12a (1); B14 (2 females ov. (4.0, 4.5 mm) with slide mounts).
Vancouver I., South End: Sidney Spit, ELB Stn., August 19, 1955: F9 (1); ELB Stn., May 17,1977: BSa (l); Quinsam I., E. Black coll., May 5, 1981: (2); Victoria Region, C. Low coll., August 7, 1981: 1 female ov. (4.0 mm) with slide mount. Off Cape Caution, Fisheries Research Board of Canada coll., 1968, 4 males; Haro Strait, D. V. Ellis coll., March 8, 1979: 3 specimens in 2 lots; Near Nanaimo, off French Creek, P. O'Rourke Stns, August 23, 1977: FC6: 1 male (4.0 mm) HOLOTYPE, with slide mount, CMN Cat. No. NMCC1992-0702; 4 females, 1 juvenile PARATYPES, CMN Cat. No. NMCC1992-0703; FC10: 1 female ov. (4.5 mm) ALLOTYPE with slide mount, CMN Cat. No. NMCC1992-0704; 2 males PARATYPES, CMN Cat. No. NMCC1992-0705; FCI (7); FC4 (6); FCS (2); FC7 (l); FC9 (5); FC13 (2) Mainland Coast: English Bay, ELB Stn. B4, June 16,1976: (5).
Coastal Shelf, Institute of Ocean Sciences, 1979-81: lD3-BM (8, with slide mount of male (3.5 mm); lD3-Al (l male, 1 female); lDl-BS (1 female, 1 imm.); lDl-B4 (1 imm,); lD3-B2 (1 female); lAS-BM (2 females); lD3-A3 (1 female); lD3-B6 (2); lD2-AS (1 female (3.5 mm) with slide mount.
WASHINGTON: Juan de Fuca Strait: off San Juan Islands, C. P. Staude coll., 1976-1978: 23 specimens in 4 lots: off Twin Rivers: (2 specimens with slide mount of female ov. (4.0 mm) CMNCat. No. NMCC1992-0706.

Diagnosis. (Male, 4.0 mm): Rostrum short, medium to narrow, apex nearly reaching middle of peduncular segment 2, antenna 1. Pigmented eyes separated dorsally by about their width. Antenna 1, flagellum 6-7 segmented, accessory flagellum 5 segmented. Antenna 2, peduncular segment 4 with 2 small groups of facial spines, and a distal cluster; segment 5 with single facial spine and 2 antero-distal calceoli; flagellum elongate, 45-50 segmented distal segments alternately calceolate except for distal 6 segments.

Epistome strongly and narrowly produced. Lower lip with weak shoulder cones. Mandible: molar small, with 4 marginal blades; spine row moderate, with 9-10 rakers and accessory setae; left lacinia 5-dentate; right lacinia bifid; palp segment 3 with cluster of 2 "A" setae. Maxilla 1, palp slightly exceeding apical spines of outer plate. Maxilliped, outer plate, apex sub-acute, inner margin with 10 masticatory spines; palp segment 2 not broadened, dactyl curved.

Coxa 4 deeper than broad, margin converging distally, lower margin nearly straight. Gnathopods 1 & 2, propods medium, widening distally, palms slightly oblique.

Peraeopods 3 & 4 not powerful, segment 5 not shortened, postero-distal spines as long as segment 6; dactyls short. Peraeopod 5, basis, hind margin convex; segment 4 little wider than deep; segment 5 deeper than wide; segment 6 sub-linear, shorter than 6. Peraeopod 6, segment 4 50% longer than wide; segment 5 much shorter, margins subparallel; segment 6 linear, hind margin weakly setose; dactyl medium. Peraeopod 7, basis, distal margin with 4 distinct teeth, size increasing distally, distal margin nearly straight; segment 5 'swollen' strongly setose behind, copulatory spines straight, subequal, distally setulose; dactyl slender.

Pleon plate 2, lower hind angle very broadly obtuse; lower margin setose anteriorly. Pleon plate 3, hind margin rounded, lacking setae. Uropod 1, peduncle with cluster of 2 baso-facial setae; peduncle with 2-3 inner marginal spines, but lacking displaced spine; rami sub-equal, posterior margin of each with 1 spine; Uropod 2, peduncle with 3-4 stout outer marginal spines; rami sub-equal, outer margin with 1 posterior marginal spine. Uropod 3, rami narrowly lanceolate, inner shorter, margins moderately strongly plumosesetose.

Telson, apices of lobes subacute, each with 2 sub-equal, long, slender spines, and setule.

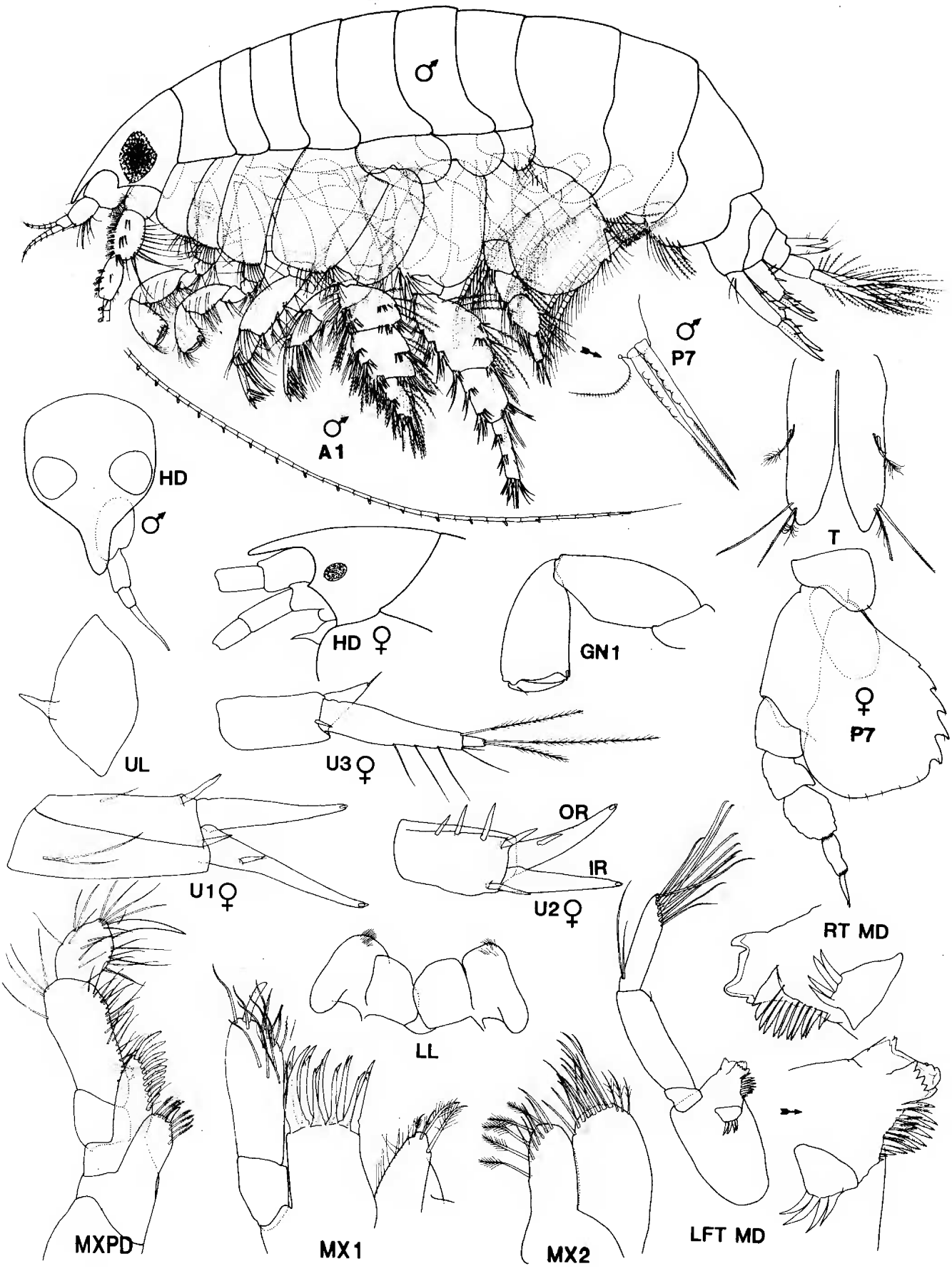
Coxal gills on peraeopods 2-6 large, elongate, distally subacute; on peraeopod 7, small, rounded below.

Female ov. (4.5 mm): Pigmented eyes small, nearly horizontally elliptical. Antenna 2, peduncular segment 4 with 2 distinct facial groups of spines and a distal group; segment 5 with 1-2 facial spines; flagellum 8-9 segmented.

Uropod 3, inner ramus very short, elongate-conical, apex with seta; outer ramus about 40% longer than peduncle, outer margin with a few simple setae; terminal segment distinct, apex with 2 plumose-setae.

Taxonomic commentary: Diagnostic features of this northern material agree fairly closely with those described initially by Barnard (1960, plate 4). Minor differs include the narrower rostrum, slightly stronger gnathopods, and sub-

Fig. 23. ***Rhepoxynius boreovariatus*** , new species. MALE (4.0 mm) HOLOTYPE; FEMALE ov. (4.5 mm) ALLOTYPE. (SEE PAGE 115 - OPPOSITE)


♂
♂ P7
♂ A1
HD ♂
HD ♀
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equal apical paired slender spines of the telson lobes, relative to the conditions in the Californian specimens. Major differences with *R. variatus* Barnard are given in the key (p. 108).

Distribution and Ecology. Central British Columbia, Vancouver Island, and Washington State, on sandy mud, sub-tidally to about 40 m. in depth.

Rhepoxynius variatus (Barnard, 1960)

Paraphoxus variatus Barnard, 1960: 198, pl. 3.
non *Paraphoxus variatus* Barnard, 1960, pl. 4.
non? *Rhepoxynius variatus* Barnard & Barnard, 1982a: 24, fig. 4.

Taxonomic commentary. The original description of Barnard (1960) embraced two or more dis- tinct species, as indicated by the 'variation' in major character states of material from different stations in his Table 3. The first species illustrated under this name (a 4.0 mm female from station 2310-53, plate 3) becomes, by priority, and by Barnard's designation of this station as the type locality, the HOLOTYPE of the name 'variatus'. The 4.75 mm. female from Sta. 2618-54, portrayed in his Plate 4, and many of the other materials listed in Table 3, apply to other, apparently distinct, but unnamed species. Barnard and Barnard (1982a) subsequently ascribed to the name '*variatus*' a 3.11 mm female and a 2.77 - male, from AHF VELERO IV Sta. 5973, as well as accessory (smaller) female and male specimens from Sta. 5180, and other (earlier) material from off Corono del Mer, southern California. Unfortunately, as those authors did not clarify the original species type and, as indicated by some of their descriptive detail (almost no figures provided), they may have treated a very closely similar third species in their VELERO material.

In collections from the present study region (north of California) no specimens referable to the designated type of *variatus* (above) have been found to date. However, several lots of specimens closely referable to the apparently unnamed species of Barnard's (1960) Sta. 2618-54 and Plate 4 are described and named elsewhere in the paper (p.114) as *Rhepoxynius boreovariatus,* new species. Critically diagnostic character states from Barnard's original type species, R. *variatus,* are summarized below:

Diagnosis (Female ov., 4.0 mm): Rostrum large, narrow, sharply rounded apex reaching end of peduncular segment 2 of antenna 1. Antenna 2, peduncular segment 5 with a single facial spine.

Upper lip, epistome acutely produced. Mandible, palp segment 2 stouter than 3, the latter with a group of two "A" setae. Lower lip with cones. Maxilla 1, palp segment 2, length about twice width.

Gnathopods 1 & 2 slender, propods thin, palms vertical.

Peraeopod 3 medium strong, segment 6 not shortened, with 2 slender postero-distal spines nearly equal in length to segment 6. Peraeopod 5, basis broad, hind margin nearly straight; segment 4, width 1.5 X depth; segment 5 sub-equally broad and slightly deeper; segment 5 slightly shorter than 5, widest medially. Peraeopod 6, segment 6 expanded, about 60% deeper than broad; segment 5 shorter than 4, broader than linear segment 6; dactyl short. Peraeopod 7, basis posteriorly with 4 large sub-equal prominent teeth, distal margin 'squared', almost straight; segment 5 slender, hind margin with a few long setae; dactyl medium.

Pleon plate 2, evenly rounded below, lower margin richly plumose-setose; pleon plate 3, hind corner obtuse, with very slight acumination; lower margin posteriorly long-setose. Uropod 1, peduncle apparently lacking inner marginal spines (except apical spine), displace spine lacking; rami sub-equal, without posterior marginal spine(s). Uropod 2, peduncle with 2-3 stout marginal spines; inner ramus only slightly the shorter, both lacking posterior spines. Uropod 3 inner ramus very short, conical, length about equal to terminal segment of outer ramus, outer margin of which bears distally a few long slender setae; apex bi-setose.

Telson lobes, apices subacute, each with an unequal pair of slender spines.

Coxal gills not described.

Mature Male not described nor figured. Sexually diagnostic features are probably similar to those illustrated for *R. boreovariatus,* new species, and varieties (e.g. Barnard, 1960, plate 4).

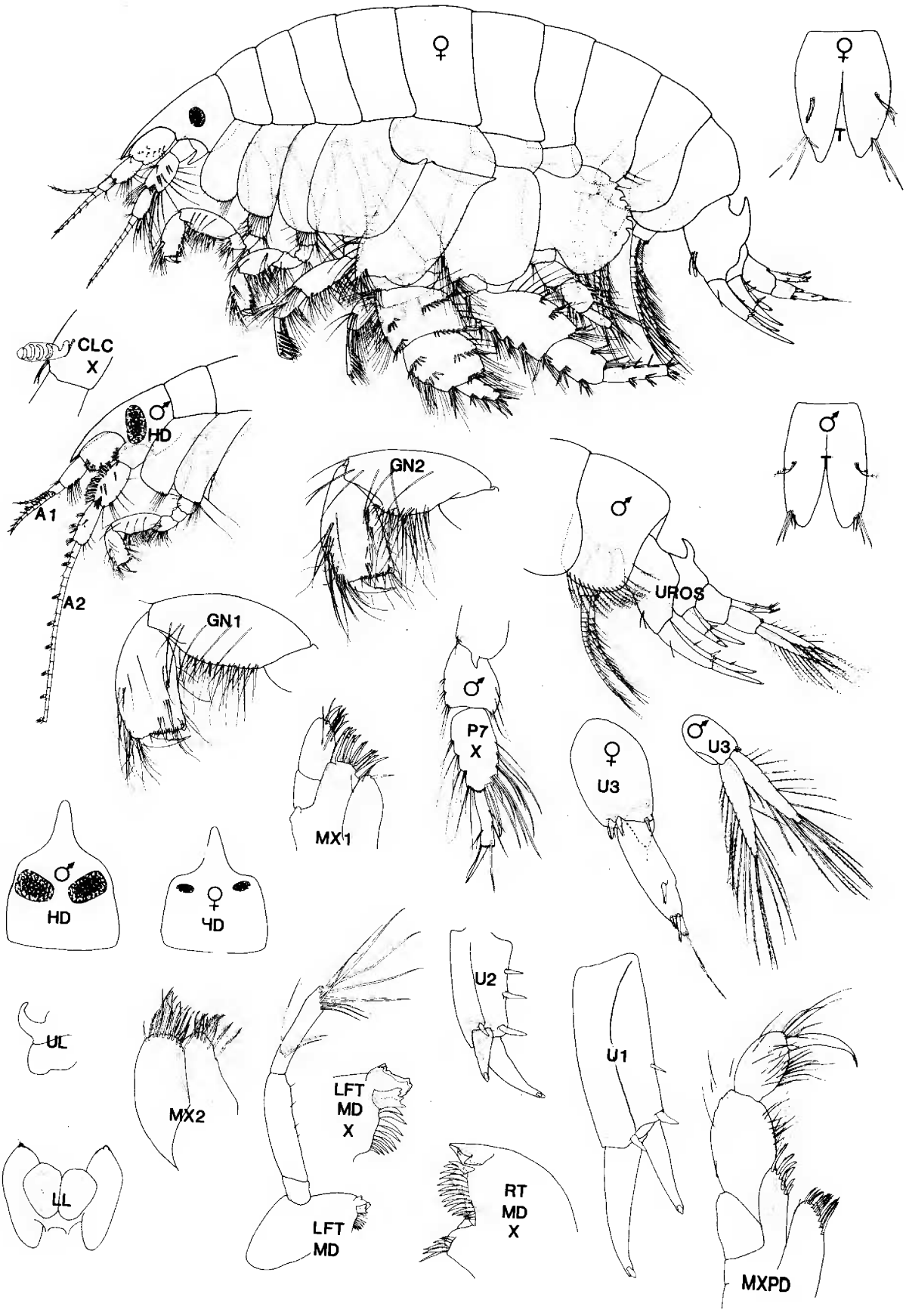
Distribution and Ecology. Off Southern California coast, on sandy mud bottoms, at depths of 10 m. to more than 100 m., but mostly shallower than 40 m.

Rhepoxynius vigitegus (Barnard, 1971)
(Fig. 24)

Paraphoxus vigitegus Barnard, 1971; 70, figs. 44-46.—
Barnard & Barnard, 1982b: 47.

Material Examined.
BRITISH COLUMBIA: Vancouver I., McKenzie Beach, sand at LW, ELB Sta. P703, July 7, 1970: 1 male, 1 female ov., 1 sub-adult female CMN Cat. No. NMCC1992-0707. McKenzie Beach, medium fine sand at LW level, D. McLeay coll., November 9,1990:1 female ov (4.5 mm) with slide mount, fig'd., RBCM Collections; 1 male (4.0 mm), with slide mount, fig'd., RBCM Collections.

FIG. 24. ***Rhepoxynius vigitegus*** **(Barnard).**
FEMALE (4.5 mm); MALE (4.0 mm).
(SEE PAGE 117 - OPPOSITE)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UROS
P7
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U3
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UL
MX2
LFT
MD
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U2
U1
LL
LFT
MD
RT
MD
X
MXPD

Diagnosis. The species has been thoroughly described and figured by Barnard (1971) and Barnard & Barnard (1982b) above. Further diagnostic aspects of this distinctive species are added below:

Female ov. (4.5 mm): Rostrum short, narrowing to acute apex. Antenna 2, peduncle 5 lacking facial spines.

Epistomal process strong, recurved upwards. Mandibular palp segment 3, with single cluster of three "A" setae. Maxilla 1, palp short, little exceeding apical spines of outer plate. Maxilla 2, inner plate distinctly narrower than outer. Maxilliped, segment 2 broad; dactyl curved, falciform.

Coxal 4 very broad, margins little converging distally, lower margin nearly straight, postero-medial process acute. Gnathopods 1 & 2 slender; propods not expanded distally, pale vertical.

Peraeopods 3 & 4 not stout, segment 5 relatively long; distal spines of segment 6 long and slender; dactyl slender. Peraeopod 5, postero-proximal process of basis acute, reaching hind margin of coxa; segment 5 as broad as segment 4, fore and hind margins convex. Peraeopod 7, hind margin of basis with 5-6 deeply separated, evenly "capped", saw-toothed serrations.

Uropods 1 & 2, rami markedly unequal (inner shorter), posterior margins bare. Uropod 3, inner ramus very short, sub-conical, little longer than broad. Coxal gills large, sac-like on peraeopods 2-6, short, small on peraeopod 7.

Male (4.0 mm.): Rostrum slightly broader, less sharply incised than in female. Eyes large, vertically subrectangular, nearly meeting mid-dorsally. Antenna 1, flagellum 8-9 segmented, calceolate on proximal 5 segments. Antenna 2, peduncular segment 5 with single facial spine, 2 antero-distal calceoli; flagellum elongate (25-segmented?), alternate segments calceolate.

Peraeopod 7, copulatory spines of segment 5 slender, subequal, distally smooth, curving forwards, proximally denticulate.

Uropod 3, rami narrowly lanceolate, margins moderately plumose-setose; terminal segment short, with 2 apical setae. Telson lobes, apical slender spines longer than in female.

Distribution and Ecology. From central B.C., LW level, to off Oregon, 30 m in sand. The sexually mature specimens of this medium-depth species that were netted along the B.C. shoreline in November (also taken there during a previous survey in July-August) may be the result of entrapment in wind-driven surface waters during pelagic mating activities at the time.

Taxonomic commentary. The present adult female differs from the original type material from off Oregon in features that are here considered of varietal significance only. Theseinclude the more numerous pigmented eye facets, in a definitive eye region; less strongly spinose uropod l; shorter inner ramus of uropod 3; and more acutely pointed telson lobes.

Rhepoxynius bicuspidatus (Barnard, 1960)

Paraphoxus bicuspidatus Barnard, 1960: 218, pls. 15, 16.—Barnard, 1964: 243, fig. 12.—Barnard, 1971: 68-70.---Barnard & Barnard, 1982a: 44.

Taxonomic remarks. Barnard (1960, loc. cit) appears to have included at least two distinct species in his original description of *R. bicuspidatus.* Although the designated type specimen is a 3.3 mm. female from Santa Maria Bay, Baja California, he has figured (plate 15) a 4 mm. female from Sta. 2610-54, and parts of a 4.5 mm. female and 3 mm. male from other stations off Huntington Beach, Southern California. The two figured females show striking differences in the form and position of the two strong spurs on the hind margin of the basis of peraeopod 7, and in the relative lengths of the inner ramus of uropod 3. Barnard and Barnard (1982, loc cit) have described in considerable detail yet another 4.57 mm. female, and a 3.86 mm. male from southern California that differ in other details such as armature of the telson lobes, and recorded the total range of all forms as 'Oregon to Baja California, 8-475 m.'. Whatever form may prove to be the type of the species *R. bicuspidatus,* none of these has been detected in material from the present, more northerly study region.

For comparative purposes, the form of *R. bicuspidatus* illustrated by Barnard (1960, plate 15) is briefly diagnosed here, and is included in the key to species (p.).

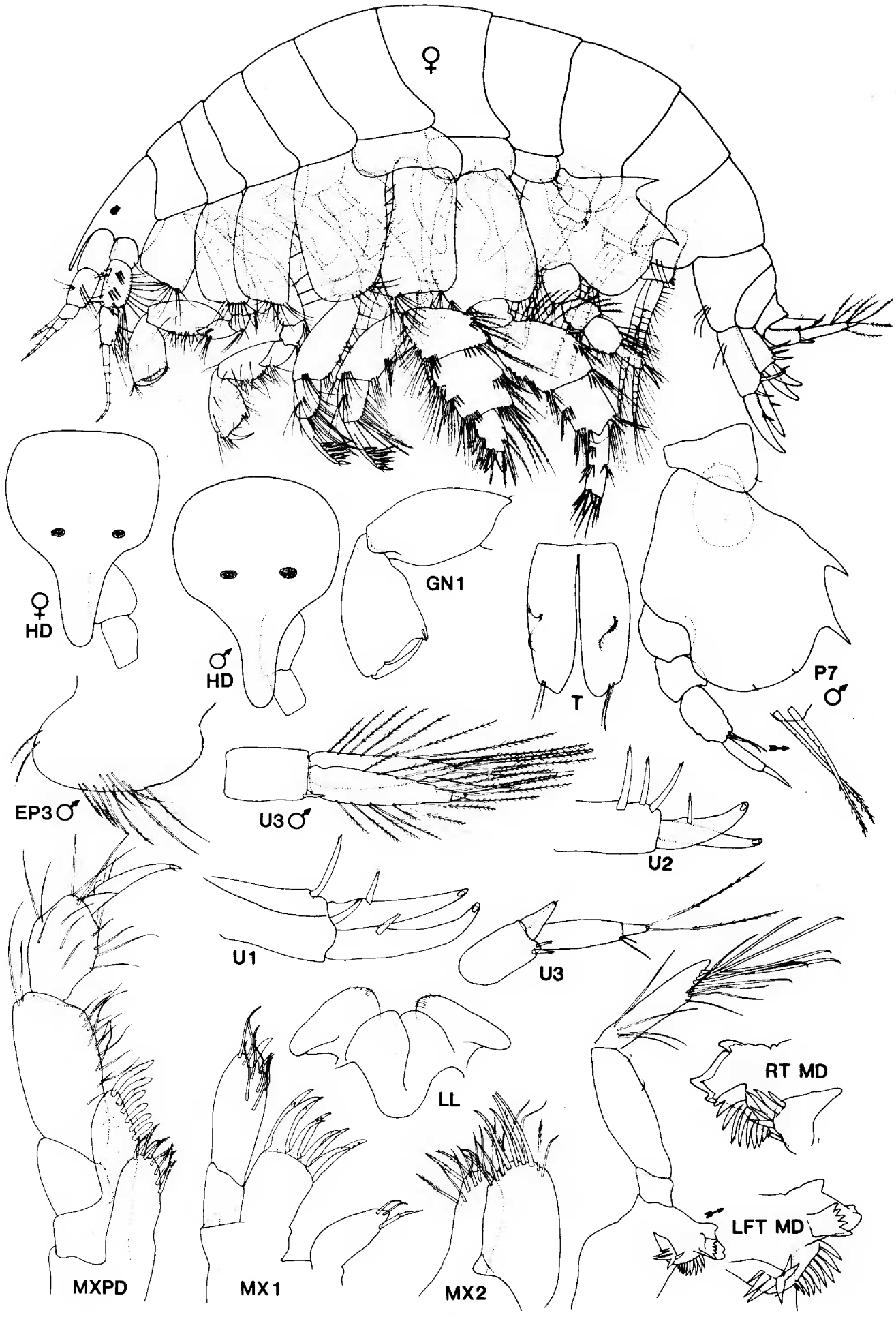
Diagnosis (Female ov., 4.0 mm). Body short, very broad. Rostrum narrow. Antenna 2, segment 1 strongly ensiform; segment 4 with two facial clusters of spines (5) and distal group of 2 spines, hind margin strongly long-setose; segment 5 lacking facial spines

Epistome produced very slightly. Mandible, molar small, with few marginal blades; spine row short; palp segment 3 with cluster of 2 "A" setae. Maxilla 1, palp longer than apical spines of outer plate. Maxilliped, palp segment 2 greatly broadened, dactyl nearly straight.

Gnathopods slender, propods not widening distally, palms nearly vertical. Coxa 4 deeper than broad, margins converging distally, lower margin gently rounded, hind process rounded.

Peraeopod 3 medium-strong, segment 5 somewhat deepened, 2 postero-distal spines exceeding length of segment 6 in which the lateral spines are clustered sub-apically; dactyl short. Peraeopod 5, basis hind margin nearly straight; segment 4 about 25% wider than deep; segment 5 slightly

Fig. 25. ***Rhepoxynius barnardi,*** new species. FEMALE ov. (3.0 mm.) HOLOTYPE; MALE (4.0 mm) ALLOTYPE (SEE PAGE 119 - OPPOSITE)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P7 ♂
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MX1
MX2

deeper, slightly narrowing distally; segment 6 short, 'thick'; dactyl small. Peraeopod 6, segment 5, length about twice width; segment 5 short, slightly narrowing distally; segment 6 linear, with 2 posterior groups of spines. Peraeopod 7, basis, upper posterior spur longer than the lower spur, distal margin nearly straight; segment 6 not swollen or broadened, shorter than segment 6; dactyl medium.

Pleon plate 3, lower margin setose near hind corner. Uropod 1, peduncle with 4 inner marginal spines increasing distally; displaced spine lacking; rami unequal, each with small posterior marginal spine. Uropod 2, peduncle with 4 stout outer marginal spines; outer ramus with 1 posterior marginal spine. Uropod 3, inner ramus very short, tall-conical; outer ramus with 2-3 outer marginal spines; terminal segment distinct, apex short-setose.

Telson lobes apically subacute, each with two short slender spines and setule.

Mature Male: The 3.0 mm specimen from another station figured by Barnard (1960, plate 16) exhibits a medium broad rostrum and very large pigmented eyes, nearly meeting mid-dorsally.

Distribution and Ecology. Oregon to Baja California, 8-475 m. (Barnard & Barnard, 1982a).

Taxonomic commentary. *Rhepoxynius bicuspidatus* (and species complex) is unique and unmistakable in having two prominent spurs on the outer margin of the basis of peraeopod 7. It is a morphologically apomorphic species, with closest relationships to the *R. variatus* complex of species and forms.

Rhepoxynius barnardi, new species
(Fig. 25)

Rhepoxynius bicuspidatus Barnard & Barnard, 1982a: 44 (partim).

Material examined.
BRITISH COLUMBIA: Southern Vancouver Island: Esquimalt, off McCauley Point, fine sand at 59 m., G. W. O'Connell coll., August 26,1976: 1 female ov. (3.0 mm) HOLOTYPE with slide mount, CMN Cat. No. NMCC1992-0708; 1 mature male (4.0 mm) ALLOTYPE, with slide mount, CMN Cat. No. NMCC1992-0709; 5 female PARATYPES, CMN Cat. No. NMCC1992-0710.

Diagnosis. Since the form of the type species has not yet been clarified (see p. 118 above), the present diagnosis will be restricted largely to points of difference with the closest previous morphology, that figured by Barnard (1960, Plate 15).

Female ov. (3.0 mm): Rostrum long (almost = head length), narrow, sharply rounded apex nearly reaching mid-point of peduncular segment 2 of antenna 1. Antenna 2, peduncular segment 4 with 2 facial groups of spines (3 per group) and a distal group of 3 spines peduncular segment 5, lacking facial spines.

Epistome not produced. Mandible, molar weak, with 5-6 marginal blades; spine row weak, with 7-8 rakers; right lacinia bifid, left lacinia 5-dentate; incisor tricuspate; palp segment 3 with cluster of 3-4 medium "A" setae. Maxilliped, outer plate short, with 7 inner marginal masticatory spines; palp segment 2 not noticeably broadened dactyl curved distally.

Coxae 1-3 relatively broad, deepening progressively posteriorly. Coxa 4 distinctly deeper than broad, margins little converging below, hind process subacute. Gnathopod propods distinctly widening distally, palms oblique.

Peraeopods 3 & 4 medium strong, postero-distal spines of segment 5 reaching end of segment 6; postero-distal spines of segment 6 long and slender, occupying distal half of segment 6; dactyl short. Peraeopod 5, basis hind margin very slightly emarginate; segments 4 & 5 moderately broadened, 5 distinctly longer than 4, margins not narrowing distally; segment 6 very short. Peraeopod 6, segment 4 relatively short and broad, depth only 30% greater than width; segment 6 with 1 group of posterior marginal spines; dactyl short. Peraeopod 7, basis subovate, upper spur of hind margin not larger than lower spur, distal margin convex, not straight; segment 5 'swollen', nearly as wide as long; segment 6 not longer than 5; dactyl slender, long.

Pleon plate 3, lower marginal setae not reaching hind corner. Uropod 1, peduncle with 3 baso-facial setae, a single large inner marginal spine, but lacking a displaced spine; rami each with single posterior marginal spine. Uropod 2, outer margin of peduncle with 2 tall postero-distal outer marginal spines; inner ramus with single posterior marginal spine. Uropod 3, inner ramus short, tall-conical; outer ramus lacking outer marginal spines or setae; terminal segment distinct, with 2 apical plumose setae.

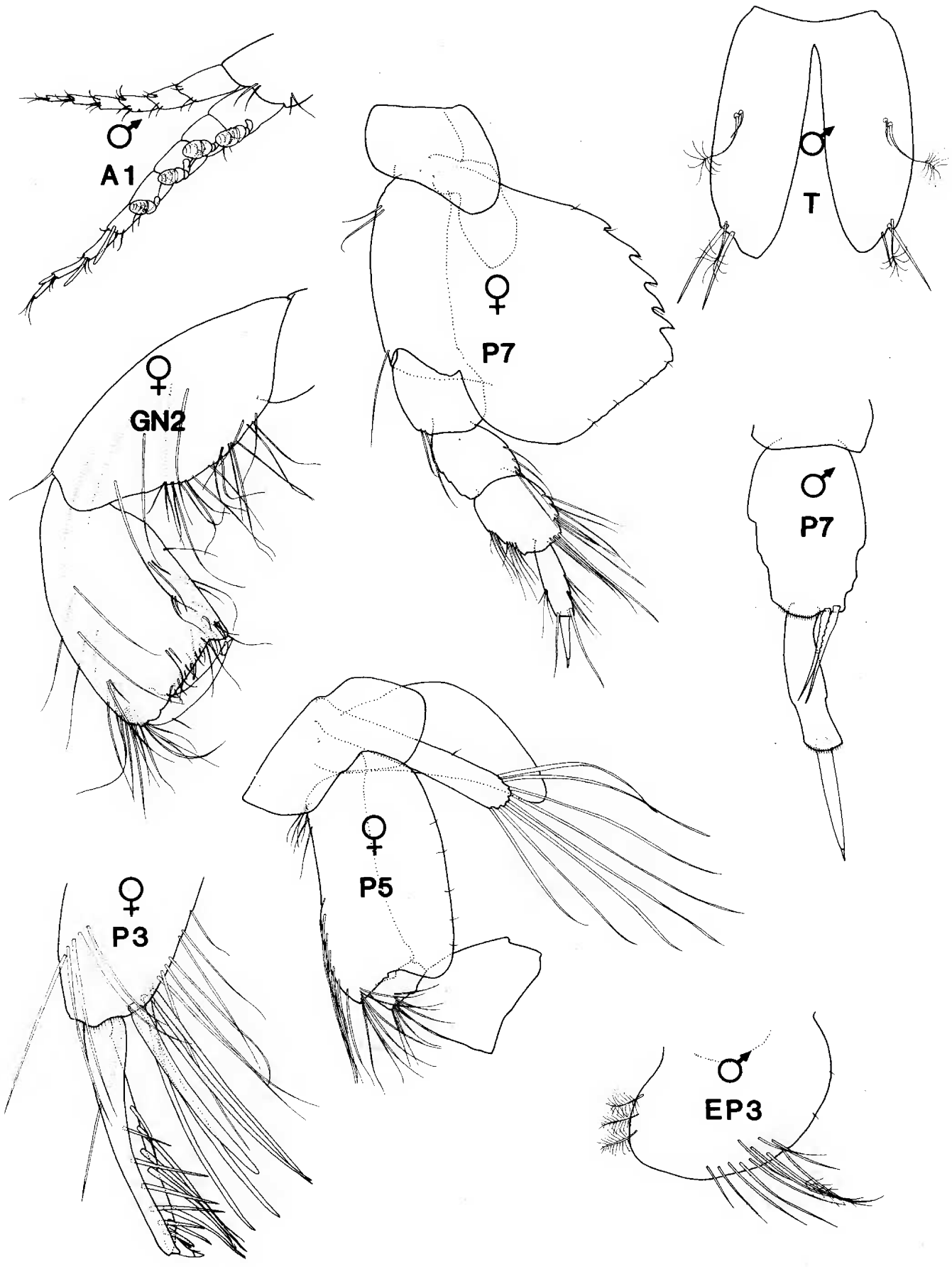
Telson apices each with 2 sub-equal, slender, closely set setae. Coxal gills on peraeopods 2-6 of medium size, slender; gill on peraeopod 7 small, rounded.

Mature male (4.0 mm): Pigmented eyes in specimen at hand are little larger than in female. Rostrum relatively slightly longer. Antenna 1, proximal 5 segments of 7-segmented flagellum of antenna 1, with calceoli. Antenna 2, peduncular segment 5 with 2 antero-distal calceoli; flagellum elongate, with calceoli on alternate segments except last 4-5.

Peraeopod 7, segment 5 not as broadened as in female, copulatory spines very slender, length about half of slender segment 6, slightly curved forwards anteriorly.

Uropod 3, rami sub-equal, margins moderately plumose-setose; terminal segment small.

Fig. 26. ***Rhepoxynius daboius*** Barnard
MALE (3.5 mm); FEMALE (3.75 mm).
(SEE PAGE 121 - OPPOSITE)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EP3

Etymology. Named in honour of the late Dr. J. Laurens Barnard whose impact on the systematics and biogeography of North American-Pacific amphipods, and especially the Phoxocephalidae, has been profound.

Taxonomic commentary. This species of the *bicuspidatus* group exhibits mainly apomorphic character states, and is apparently closest to the *variatus* complex. The small size of the pigmented eyes in the mature male specimen at hand may be anomalous.

Distribution and Ecology. Known only from the type locality, near Victoria, British Columbia, at the southern tip of Vancouver Island, in fine sand at 59 m. that is exposed sporadically to effluent from a major submarine sewage outfall.

Rhepoxynius daboius (Barnard, 1960)
(Fig. 26)

Paraphoxus daboius Barnard, 1960: 210, pls. 10,11.
Rhepoxynius daboius: Barnard & Barnard, 1982a: 30.

Material examined.
BRITISH COLUMBIA: North Central Coast: Open Bight, in fine muddy sand, at 25 m., ELB Stn. H37, July, 1964: 1 female ov. (3.5 mm) with slide mount, fig'd., CMN Cat. No. NMCC1992-0711.
Vancouver Island: Trevor Channel, dredged in muddy sand at 45-50 m., ELB Stn. B14, May 25, 1977: 47 specimens, including 1 male (3.75 mm), with slide mount, fig'd. CMN Cat. No. NMCC1992-0712.

Taxonomic remarks. This species has been fully figured by Barnard (1960, loc. cit). It is closely similar to *R. fatigans* in the weakly produced epistomal cusp, few "A" setae of the mandibular palp, powerful maxilliped palp, strongly rounded coxa 4, form of peraeopod 7 basis, narrow pleon plate 2, and weakly spinose uropods 1 & 2, among other, mainly apomorphic character states.

R. daboius differs from *R. fatigans* chiefly in its more powerfully suhchelate gnathopods, less broadly expanded segments 4 & 5 of peraeopod 5, straighter postero-distal margin of the basis of peraeopod 7, and the fewer slender apical spines of the telson lobes.

Distribution and Ecology. A typically deep-water species in fine mud and sandy mud, 77-813 m., shallower in the north, from north central British Columbia south through Oregon to southern California. The present record extends the range north from Oregon.

Rhepoxynius fatigans (Barnard, 1960)
(Fig. 27)

Paraphoxus fatigans Barnard, 1960: 209, pl. 9.—Barnard, 1966: 28, 29, figs. 6, 7.
Rhepoxynius fatigans Barnard & Barnard, 1982a: 28.

Material examined.
BRITISH COLUMBIA: North central coast: Goose Island Anchorage, ELB Stn. H49, August 5,1964: 3 females, 1 penult. male.
Vancouver Island, Barkley Sound region: Trevor Channel, off Brady's Beach, fine sand at 20 m., ELB Stn. B10c, June 28, 1976: 5 females, 1 penult male, 3 immatures. Pachena Bay, gray whale feeding pits, 20 m., P. Slattery coll., April 17, 1983 - 37 females & immatures, with slide mounts of 1 female ov. (3.0 mm), 1 male (2.5 mm), fig'd. CMN Cat. No. NMCC1992-0713. Coastal Shelf, off Vancouver I., Institute of Ocean Sciences, ID3-DM, 1979-81: 3 females.
WASHINGTON: Juan de Fuca Strait: Neah Bay, low intertidal silty sand, ELB Sta. W39, July, 1966: 1 immature. Off San Juan I., C. P. Staude Stn. KGB-10, May, 1978, Lot 1:14 females, 6 penult. males with slide mounts of 1 female ov (3.25 mm), fig'd., and 1 female ov. (3.5 mm) mouth parts fig.'d, CMN Cat. No. NMCC1992-0714; Ibid, Lot 2: 4 females, 9 penult males; Ibid, Lot 3: 12 females.

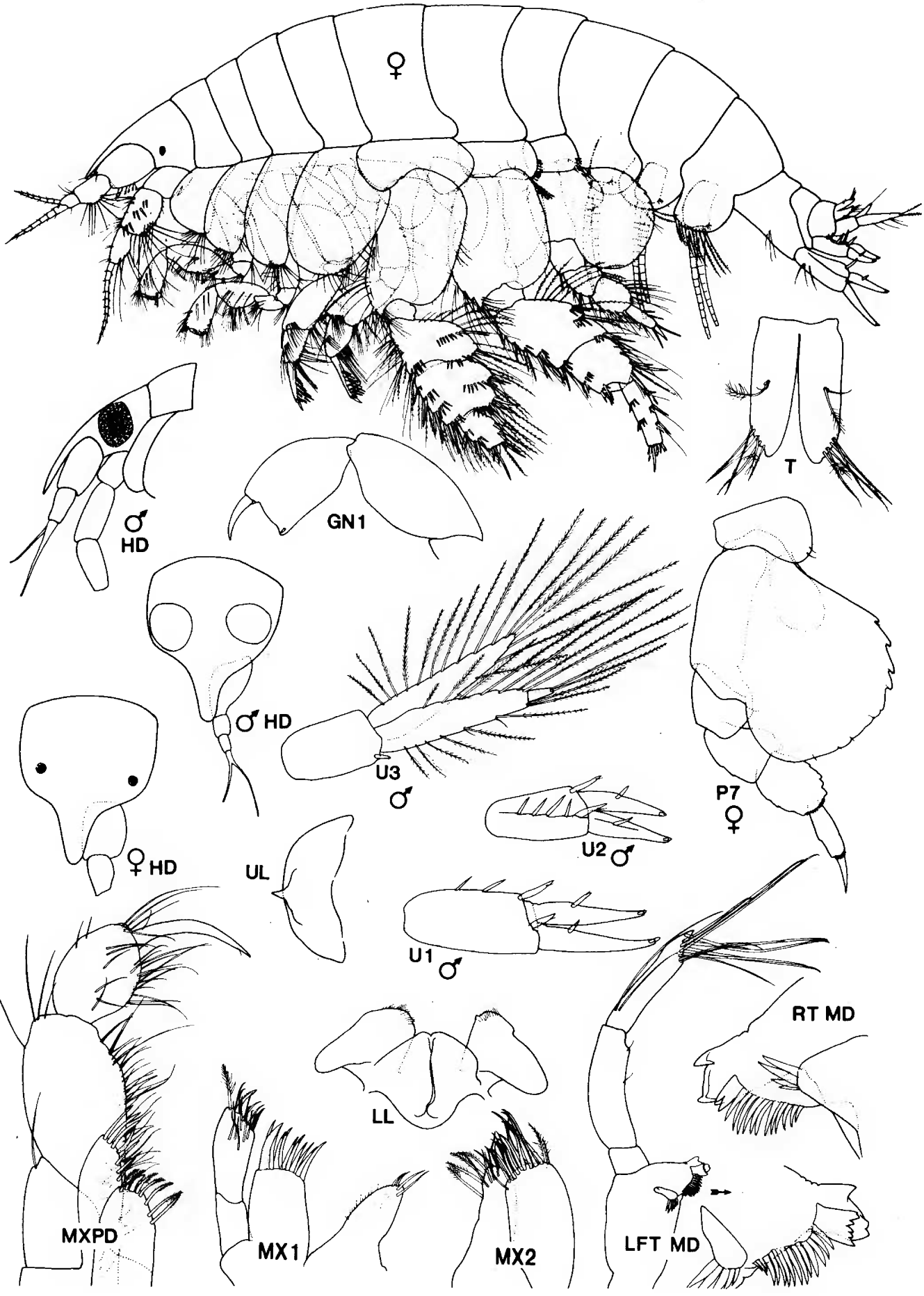
Diagnosis. (Female, 3.25 mm): Pigmented eyes very small, round. Rostrum medium, narrow, subacute apex reaching peduncular segment 2, antenna 1. Antenna 1, peduncular segment 1 large, stout; flagellum and accessory flagellum each 6-segmented. Antenna 2, segment 4 with 3 clusters of facial spines; segment 5 lacking facial spines; flagellum 9-10 segmented.

Epistome slightly produced, process length about equal to width Mandible: molar small, with 4-5 marginal blades; spine row medium with about 12 rakers; left lacinia irregularly 5-dentate, right lacinia subequally bifid; incisor narrow, tricuspate; palp segment 2 bowed; segment 3 with cluster of 2 long "A" setae. Maxilla 1, palp segment 2 broadening to truncate apex, not exceeding outer plate spines. Maxilla 2, inner plate small. Maxilliped, inner plate relatively large; outer plate slender, with 8 slender masticatory spines; palp segment 2 broad; dactyl slender, strongly curved or falcate.

Coxae 1-3 medium, increasing in length posteriorly, lower margins rounded. Coxa 4, lower margin rounded, continuous with anterior and posterior margins, hind process quadrangulate. Gnathopods slender; propods little expanded distally, palms vertical.

Peraeopods 3 & 4 strong, segment 5 short, postero-distal spines not reaching end of segment 6; segment 6, posteriorly spinose along more than half of margins; dactyls medium. Peraeopod 5, basis large, broad, hind margin straight; segment 4 strongly broadened; segment 5 deeper; segment 6 short, 'thick'; dactyl short. Peraeopod 6, segment 4 broad, about 35% deeper than wide; segment 5 almost as broad, margins slightly convex; segment 6 linear, hind margin with 3 groups of spines and slender seta; dactyl slender. Peraeopod

FIG. 27. ***Rhepoxynius fatigans*** (Barnard).
FEMALE ov. (3.5 mm); MALE (2.5 mm).
(SEE PAGE 123 - OPPOSITE)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P7 ♀
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MX2
LFT MD

7, basis sub-rotund, hind margin with 4-5 small teeth, distal margin nearly straight; segment 5 'swollen', strongly setose behind; segment 6 not longer than 5, hind margin with 2 spines; dactyl medium.

Pleon plate 2 strongly rounded below, little or not overlapping pleon 3, the latter with rounded hind corner, strongly setose ventrally. Uropod 1, peduncle with 1 stout inner distal marginal spine, displaced spine lacking; rami each with one posterior marginal spine. Uropod 2, peduncle, outer margin with 4-5 stout spines; rami each with single posterior marginal spine. Uropod 3, inner ramus short, conical, with single apical seta; outer ramus, outer margin with a few distal setae; terminal segment with 2 apical plumose setae.

Telson lobes each with 4-6 long slender apical spines and single setule. Coxal gills medium broad, curve-tipped, on peraeopods 2-6, short and pear-shaped on peraeopod 7.

Mature Male (2.5 mm): Pigmented eyes ovate, separated mid-dorsally by less than their diameter. Antenna 1, flagellum calceolate on proximal 6 flagellar segments. Antenna 2, segment 5 with single facial spine and 2 anterodistal calceoli; flagellum elongate (40 + segments), calceolate on alternate segments.

Peraeopod 7, copulatory spines not observed. Uropod 3, rami plumose setose on all margins, terminal segment distinct.

Taxonomic commentary. The present material differs very little from that described originally as R. *fatigans* by Barnard (1960, plate 11) from off Santa Catalina Island, Southern California, except that the mandibular palp has two (rather than one) "A" setae, and apical slender telson spines are more numerous.

Distribution and Ecology. From the north-central coast of British Columbia, south through Washington and Oregon to Baja California, on fine sandy mud, in sub-tidal depths, generally 20-100 m, to more than 330 m.

TAXONOMIC ANALYSIS*

The foregoing description of the rich regional metharpiniin fauna of 30 species in 7 genera raises the problem of the natural relationships and phyletic classification of the component taxonomic units. For this purpose, the characters and character states of the genera, and species within genera, have been analyzed 'semi-phyletically', using a modification of the phenetic UPGMA (cluster analysis) system of Sneath and Sokal (1973). The modification, introduced by Bousfield (1981) and adapted by Dickinson (1982), Conlan (1983), and Staude (1986) involves the phyletic ordering of character states, and calculation there from of a 'Plesio-Apomorphic (P-A.) Index' for each species. This modification permits an assessment of (1) the degree of phyletic or natural significance of morphological similarities, and (2) the relative degree of primitive or advanced condition of the sub-clusters or sub-groupings. A carefully selected matrix of 14-18 characters and corresponding 28-36 character states are considered for the analysis of (a) generic relationships (Table IX), and species relationships within (a) *Grandifoxus* (Table X), *Foxiphalus* (Table XI) and *Rhepoxynius* (Table XII). The number of characters therefore ranges between equal to, or twice, the number of corresponding taxa, and is considered adequate for modified phenetic (semi-phyletic) analysis, within the amphipod literature (above). Character states reflect the most discontinuous conditions of each character. Here the plesiomorphic condition is coded as '0' and the apomorphic or derived condition as '2'. Overlap or intergradation of some states is inevitable; such intermediate cases are coded as '1' (Tables IX-XII). Members of the Birubiinae and of the Pontharpiniinae were selected for outgroup comparison (see Bousfield, 1981). In general, character states of species of these two subfamilies are more plesiomorphic, but in some instances more apomorphic, than in species of Metharpiniinae.

With respect to preparation of corresponding phenograms, the characters and character states are provided in Tables V - VIII in the Appendix (pp. 133-136). The phenograms are included as follows: Genera of Metharpiniinae (Fig. 28); *Grandifoxus* species (Fig. 29); *Foxiphalus* species (Fig. 30); and *Rhepoxynius* (Fig. 31). Group average methods were used in the construction of phenograms.

With respect to relationships between genera, the phenogram (Fig. 28) reveals three main subclusters, viz. a *Grandifoxus* sub-grouping (encompassing also *Beringiaphoxus and Majoxiphalus*), a *Metharpinia* subgrouping (including *Microphoxus*) and a *Rhepoxynius* sub-grouping (including *Foxiphalus*). Three observations from this phenogram are especially notable: the subgroups are not closely related, with clustering splits at between 50 and 60%; the genera within subgroups are also not closely related, with 'splits' at the 65 - 75% levels; the *Grandifoxus* subgroup is the most primitive (P-A. Index of about 11), the *Metharpinia* group intermediate (P-A. Index of 18) and the *Rhepoxynius* group the most advanced (P-A. Index of 25).

In pragmatic terms, the *Grandifoxus* group is characterized by several basic plesiomorphies that are reversed or apomorphic in the *Rhepoxynius* group. These plesiomorphies include: large numbers of calceoli (7-8) on peduncle 5 of antenna 2 (male); maxilliped inner plate with 2 apical spines; mandibular spine row very strong; and uropod 2, peduncle and rami strongly spinose. Character states of the rostrum (incised or fully hooded) and uropod 1 (displaced spine, presence or absence) had been considered of major taxonomic significance previously (e. g. in Barnard & Barnard, 1982a, b; Coyle, 1982). These are here observed to vary within closely related groups, or exhibit the converse condition of otherwise primitive or advanced groups, and are thus

*** Tables V- XIII are given in the APPENDIX (p. 132)**

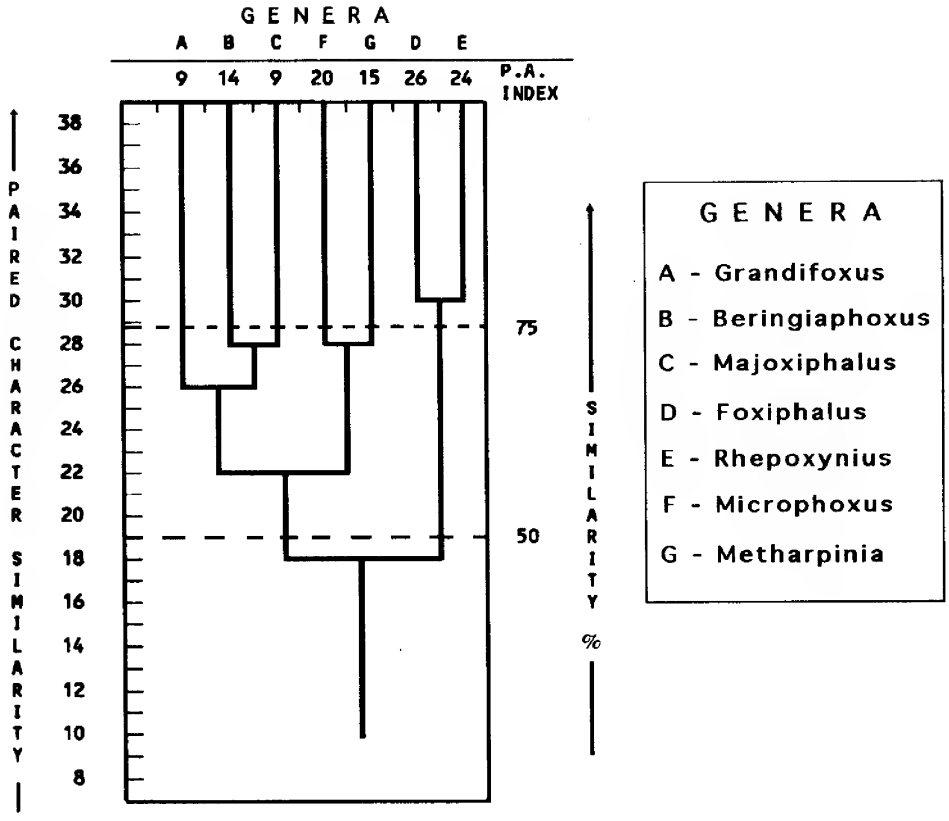

FIG. 28. Phenogram: Genera of Metharpiniinae

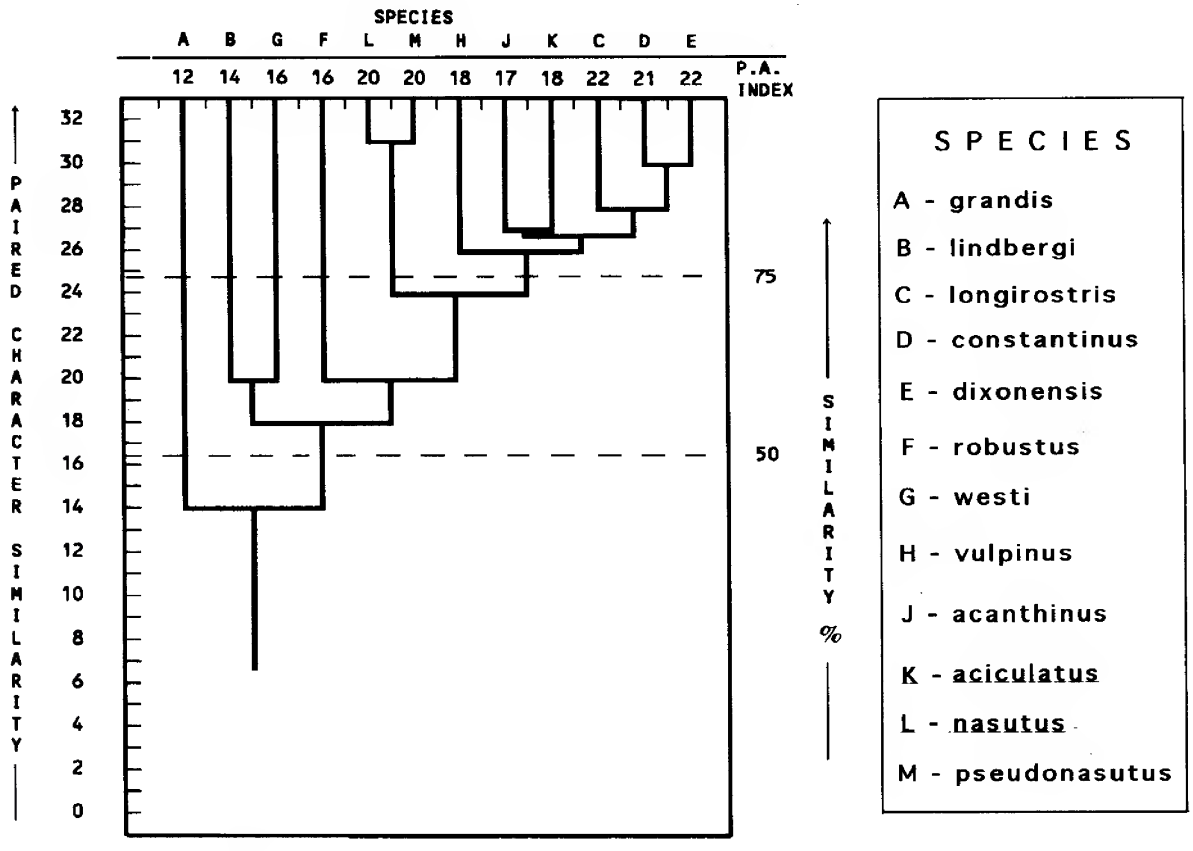

FIG. 29. Phenogram: Species of *Grandifoxus*

concluded to be now of much lesser generic (or higher) phyletic value.

With respect to species within the genus *Grandifoxus*, Fig. 29 reveals five main subclusters: *grandi* (unique); *lindbergi* (including the western Pacific species, *robustus and westi*); *vulpinus* (including *aciculatus and acanthinus*); *nasutus* (including *pseudonasutus*); and *longirostris* (including *constantinus and dixonensis*).

The following observations appear noteworthy:
(l) *G. grandis* is the most primitive species (P-A. index of 12) and phyletically remote from the others (group 'splits' at less than 50% similarity);
(2) the *lindbergi* group (including the western Pacific species) is also primitive (P-A. index of about 15) and least remote from G. *grandis* ('splits' at about 65% similarity);
(3) the *vulpinus* and *longirostris* groups are relatively advanced (P-A. Indices of 17-22) and closely related ('splits' above 80% similarity); and
(4) the *nasutus* group is also relatively advanced (P-A. Index of 20) but is isolated from the others at about 75% similarity.

The *grandis-lindbergi* subgroups share plesiomorphies such as the strongly calceolate and elongate peduncle 5 of antenna 2 in the male, and elongate rami of uropod 3 of the female, character states that are largely reversed in the advanced groups. The degree of morphological isolation of these subgroups, esp. that of *G. grandis* might allow for further generic (and certainly subgeneric) formal categorizations. Coyle (1982) also noted a similarly wide range of character stales within his distinctive Alaskan species, along with the difficulty of applying Barnard's (loc. cit.) generic criteria to its separation from *Rhepoxynius* and some of the Australian forms, but made no attempt at further generic revision. Such should reasonably await the collection of more extensive material, especially of the single-record species, and from poorly sampled areas of overlap or intergradation.

Within the larger *Rhepoxynius* group, four major subclusters can be readily identified: an *abronius* group (including *menziesi* and *lucubrans);* a *tridentatus* group (including *pallidus* and *stenodes);* a *gemmatus* group (including *homocuspidatus* and *heterocuspidatus)* and a *fatigans* subgroup (including *daboius, bicuspidatus, variatus, boreovariatus, barnardi,* and *vigitegus*). The following observations seem significant phyletically:

(l) the *abronius* subgroup is primitive (P-A. Index of 11) and isolated from the others (similarity only about 50%) whereas the others are within 65-75% similarity of each other);
(2) the *gemmatus* and *tricuspidatus* groups (occurring mainly south of the present study region) are phyletically intermediate (P-A. Indices about 20); the *fatigans* group comprises a number of mainly advanced (P-A. Indices of 20-26), but not clearly differentiated internal sub-groupings.

These sub-clustering 'break-outs' are not unlike those of the genus *Grandifoxus*, having one primitive unit isolated morphologically from the other, much more advanced, subgroupings, which, in turn, are not very closely related to each other. Plesiomorphic features shared by the primitive group include: facially spinose peduncular segment 5 of antenna 2; multi-cuspate hind margin of the basis of peraeopod 7; quadrate or acuminate hind corner of pleon plate 3; subaequiramus uropod 3 in the female; and apically short-spinose telson lobes. Here again, the presence or absence of an uropod 1 displaced spine within related species of *Rhepoxynius* appears convergent and, although its presence tends to be plesiomorphic, is of limited classificatory significance. The present species clusterings within genus *Rhepoxynius* are similar to those of Barnard and Barnard (1982b: 4), based on many of the same characters and character states. Those authors were likewise struck by the remarkable morphological diversity within the genus, and suggested that the especially distinctive species, *R. vigitegus*, might be a candidate for separate generic recognition of its own. Again, such revisionary work on a formal basis is perhaps best postponed until further material comes to hand, especially of northern, deeper-water, and single-record species.

With respect to the less speciose genus *Foxiphalus*, again four distinct sub-clusters (Fig. 30) seem clearly recognizable: the unique *aleuti* ; an *obtusidens* group (including *falciformis* and *golfensis*); *xiximeus* group (including *fucaximeus*, and less closely, *cognatus*); and a *similis* group (including *slatteryi*). Here again, we may note that:
(l) the species groups, including even the most advanced *similis* and *xiximeus* subgroups (P-A. indices of 23-25) are not closely similar to each other (less than 75% similarity); and (2) the most primitive species groups, *aleuti and obtusidens*, (PA. Indices of 16-20) are isolated from the others at little better than 50 % similarity.

Again, as noted in the *obtusidens* subgroup, the displaced spine of uropod 2 is variably present, and thus not of major taxonomic significance. The primitive subgroups share rather fewer plesiomorphies (than is the case in counterpart members of *Grandifoxus and Rhepoxynius*); one notable example is the condition of the mandibular right lacinia that is bifid in primitive, and spike-like or lacking in advanced, species. Such wide phyletic separation between the genera, and species groups within genera, indicates strongly that subfamily Metharpiniinae is both ancient and long-established on the North American Pacific coast. From indirect considerations of world distribution and comparative morphology, Bousfield (1982b) has estimated the minimum geological age of the primitive superfamily Phoxocephaloidea as Jurassic (c. 150 m.y.b.p.). In view of the relatively close morphological relationships (e.g. in antennal calceoli) of the Phoxocephaloidea to the primitive superfamily Crangonyctoidea (a continental fresh-water group that may extend back to the Triassic, or even Permian), the origin of the marine phoxo's may be older than Jurassic. The finding of such widely disjunct morphologies within one of the more primitive superfamily sub-groupings on this geologically long-undisturbed, open-oceanic Pacific North American coast is not unexpected, and tends to support the

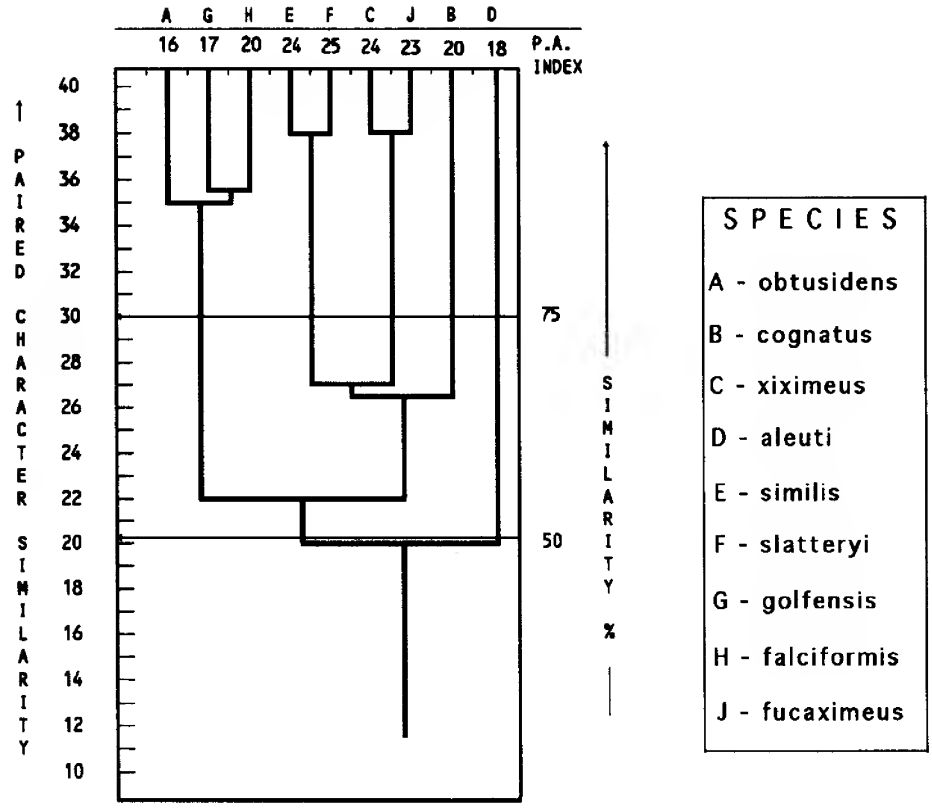

FIG. 30. Phenogram: Species of *Foxiphalus*

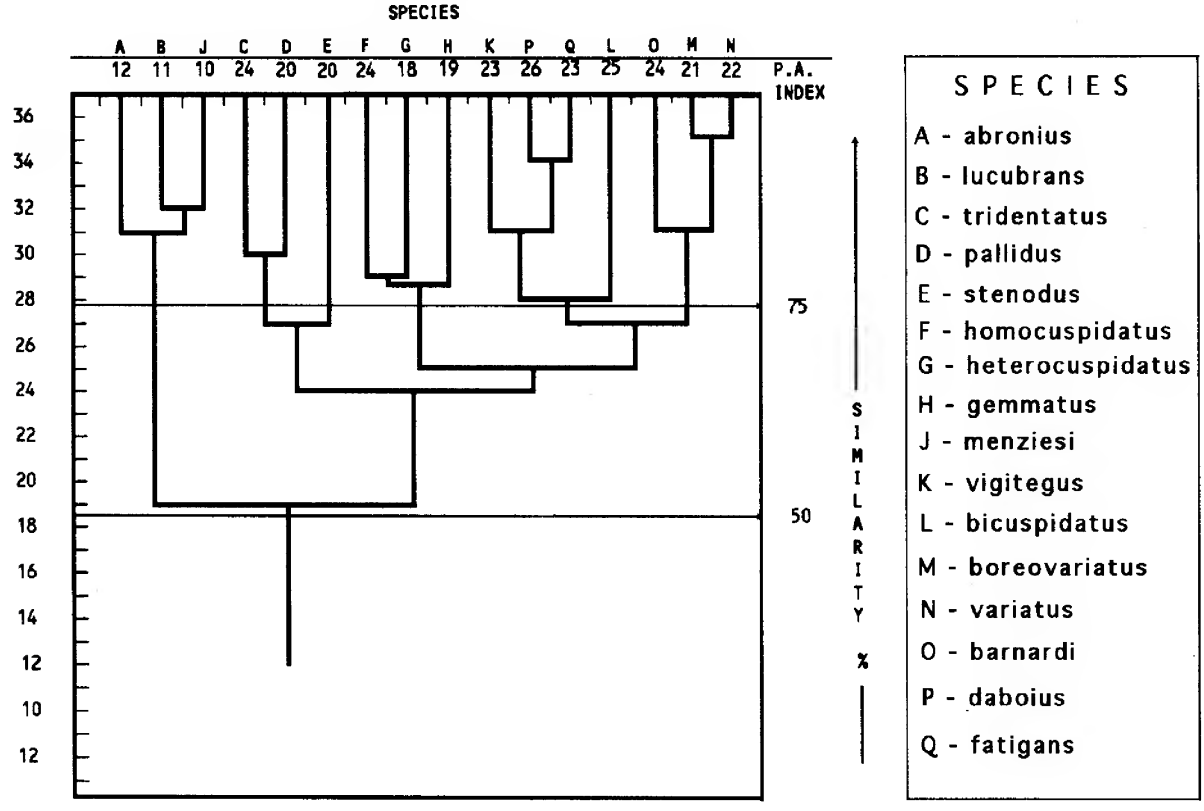

FIG. 31. Phenogram: Species of *Rhepoxynius*

primitive nature of this subfamily within the family and superfamily.

We may also note that within each generic group, member species that are relatively large and powerfully fossorial dwell in sands and coarser sediments of high energy inshore environments and tend to be the most primitive morphologically (e.g. *grandis* in the genus *Grandifoxus*; *obtusidens* in the genus *Foxiphalus,* and *abronius* within the genus *Rhepoxynius).* Conversely, members that are small, and relatively weakly fossorial (weakly expanded and weakly armed segments of antennae, peraeopods and uropods) and dwell in deeper, off-shore, fine silty sands and mud, tend to be the most advanced morphologically (e.g. *similis* within *Foxiphalus; daboius* within *Rhepoxynius*). We may fairly conclude, therefore, that the evolutionary 'thrust' within genera and species of Metharpiniinae is from large, strongly fossorial, and reproductively primitive species of inshore habitats, to smaller, less fossorial and phyletically more advanced forms that occupy deeper, offshore habitats.

DISTRIBUTIONAL-ECOLOGICAL ANALYSIS

The subfamily Metharpiniinae is largely endemic to the Pacific coast of North America, a region in which about 80% of described species have been recorded to date (Table IV). Certain features of distribution are especially noteworthy. Whereas the *Grandifoxus* group especially is diverse in the Bering Sea region, none is yet known from the Arctic or from the icy waters of the Kamtchatka region of the western Pacific. In general, however, if the essentially tropical and antipodean genera *Metharpinia* and *Microphoxus* are excluded from consideration, members of the most primitive genera are dominant at the most northerly localities, whereas those of the most advanced genera are most diverse in southern regions. Thus, members of the primitive genera *Grandifoxus* and *Beringiaphoxus* occur only from the Bering Sea southward to Central California, and also disjunctly westward in the Sea of Japan. In the advanced genus *Rhepoxynius,* by contrast, the centre of distribution is in central and southern California. Only about half the known Pacific species range northward into Canadian coastal waters, and none has yet been recorded from SE Alaska or northward. The phyletically intermediate genus, *Foxiphalus,* is also distributionally intermediate, with a centre of distribution in northern California and Oregon, and its member species range northwards in progressively diminishing numbers through coastal waters of Canada and SE Alaska to the Bering Sea. The phyletically primitive genus, *Majoxiphalus,* with two known species centred in coastal waters of British Columbia, ranges both northwards to the Bering Sea and southwards to California, thus also basically fitting the above phyleticdistributional phenomenon.

However, when individual species distributions are examined, exceptions to the above general trend may be noted. Thus, within the genus *Grandifoxus* (sens. lat.), the most primitive species, *G. grandis,* is much the most southerly. It ranges considerably south of the relatively advanced *G. longicomis* group, yet has not been recorded from either SE Alaska or the Bering Sea regions, either by Coyle (1982) or in the present extensive material. On the 'flip' side of this analysis, within the southern genus *Rhepoxynius,* one of the most primitive species, *R. abronius,* ranges as far north as even the most advanced species, *R. fatigans* and *R. daboius.* Similarly, within the southerly genus *Foxiphalus,* the most primitive species *F. aleuti* regionally co-occurs in the Bering Sea region with the advanced *R. similis* complex.

A reasonable explanation of this apparent exception may lie partly in the differing life styles and ecological requirements and partly in presumed differences in evolutionary history of the species concerned. Thus, *Grandifoxus grandis is* a relatively large, powerfully fossorial species that inhabits inshore sands and relatively coarse-grained sediments of relatively high-energy habitats. It is also apparently more broadly ecophenotypic, and tolerates a relatively wide range of temperatures (4 - 20C+), and salinities (>15 p.p.t.). Such habitats in Alaska and the Bering Sea region are only now developing during post-Pleistocene deglaciation and marine warming of coastal SE Alaska, that has presumably hitherto formed a biogeograpnic barrier to slowly dispersing inshore fossorial species (see Bousfield, 1970). Similarly, barriers to northward dispersal of more deeply subtidal rhepoxiniids may be represented by the cold coastal waters of SE Alaskan whose inlets and fiords (except for southeastern portions of Prince William Sound) are year-round icy cold, and are dominated mainly by fossorial Iysianassids, oedicerotids, pontoporeiids, and other competing groups of phoxocephalids (e. g. harpiniids) having fully arctic thermal requirements (Jarrett & Bousfield, in prep.).

LEGEND FOR TABLE III (PAGE 129 - opposite)

I. Occurrence

X - abundant in region (or presumed so)

x - marginally in region.

xS - essentally south of this region (tropical)

II. Coastal Regions (Progression: North-west to South- east)

1. Japan Sea and Western Pacific
2. Bering Sea and Aleutian Chain to Kodiak I.
3. Prince William Sound & South-eastern Alaska (N. of Dixon Entrance.)
4. North central B. C. coast and Queen Charlotte Ids. 5. Southern B.C. coast and Vancouver Island.
6. Washington and Oregon
7. Northern and Central California
8. Southern and Baja California

Acknowledgements

This study could not have been completed without the help of many biological research agencies and interested colleagues. The field surveys were carried out with the full support of the National Museum of Natural Sciences (now

TABLE IV. Distribution of North American Pacific Species of Metharpiniinae

	NORTH PACIFIC SUBREGION							
	1	2	3	4	5	6	7	8
I. GRANDIFOXUS								
robustus	X							
westi	X							
constantinus		X						
pseudonasutus		X						
nasutus		X						
vulpinus		X	x					
aciculatus		X	x	?				
acanthinus		X	X					
lindbergi	X	X	X	X	X			
longirostris		X	X	X	X			
dixonensis				X				
grandis			X	X	X	X		
II. BERINGIAPHOXUS								
beringianus		X						
III. MAJOXIPHALUS								
maximus		X	X	X	x			
major			x	X	X	X	x	
IV. FOXIPHALUS								
aleuti		X						?
slatteryi		X						
similis			x	X	X	X	X	
xiximeus			X	X	X	X	X	X
fucaximeus						X		
falciformis				X	X	X		
obtusidens						x	X	X
cognatus							x	X
golfensis								X
apache								X
secasius								xS
V. RHEPOXYNIUS								
pallidus				X	X	x		
vigitegus				X	X	X		
boreovariatus				X	X	X		
fatigans				X	X	X	X	x
daboius				x	?	X	X	X
variatus				X	?	?	x	X
abronius				X	X	X	X	X
barnardi					X	?		
tridentatus					X	?		
bicuspidatus						x	X	x
lucubrans							x	X
stenodes							?	X
homocuspidatus								X
heterocuspidatus								X
menziesi								xS
gemmatus								xS
VI. METHARPINIA								
jonesi								X
VII. MICROPHOXUS								xS

Canadian Museum of Nature) in Ottawa, and received vital technical assistance and ship-time from Canadian Pacific research centres and their staffs. These included the Pacific Biological Station, the Bamfield Marine Station, the Pacific Environmental Institute, the Royal British Columbia Museum, the University of Victoria, University of British Columbia, and the Institute of Ocean Sciences, Sidney, and, in the United States of America, the Friday Harbor Marine Laboratory and the College of Fisheries, University of Washington. Especially helpful in the provision of study material and systematics ecological commentary have been Drs. Craig P. Staude, Friday Harbor, and Peter N. Slattery, Moss Landing, USA. Full acknowledgement to individuals of those agencies, and to many others, are provided in the previously published station lists (above), to whom we again express our deepest appreciation. For advisory and curatorial assistance in preparation of this report, we are especially grateful to museum colleagues Kathleen E. Conlan, Ed Hendrycks, and Judith A. Price. Preparation of the line illustrations was most capably assisted by Susan Laurie-Bourque, Hull, Quebec. Work by the senior author and by the artist, was also supported by operational grants from the Royal Ontario Museum, Toronto, and the Natural Sciences and Engineering Research Council, Ottawa.

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APPENDIX

PAGE NO.

TABLE V. Species of Metharpiniinae: Characters, Character States, and Plesio-Apomorphic (P.-A.) Codings

	CHARACTER STATES	
CHARACTERS	**Plesiomorphic** 0	**Apomorphic** 2
1. Rostrum shape	laterally incised	fully hooded
2. Antenna 1, peduncle 2, length	elongate (> segment 1)	short (< segment 1)
3. Ant. 2, (male), no. peduncle 5 calceoli	4 - 8	1 - 2
4. Ant. 2, segment 5, no. facial spine gps	1 - 2	0
5. Mandible, right lacinia cusps	2 - 3	1
6. Mandible, blade row	long	short
7. Urosome 1, v. setae	present	lacking
8. Mxpd. inner plate no. apical spines	2	1
9. Mxpd. dactyl, form	straight	curved
10. Gnathopods 1 & 2	slender, elongate	stout, deep
11. Coxal plate 4; relative size	small	large
12. Peraeopods 3 & 4	large	small
13. Peraeopod 5, segments 4 & 5, width	narrow (W < D)	broad (W > D)
14. Peraeopod 6, segments 4 & 5, width	narrow (W < D)	broad (W > D)
15. Peraeopod 7, seg. 5	narrow	broad
16. Uropod 1, size of displace spine	large, stout	small, lacking
17. Uropod 2, ram. spines	strong	weak or lacking
18. Urop. 3 (female)	aequiramus	parviramus
19. Telson lobes, dorso-lateral spines	present (1 - 3+)	lacking

TABLE VI. Species of *Grandifoxus*: Characters, Character States, and Plesio-Apomorphic (P.-A.) Codings

	CHARACTER STATES	
CHARACTERS	**Plesiomorphic (=0)**	**Apomorphic (=2)**
1. Peraeopod 7, basis poster, serrations	strong	weak
2. Rostrum, breadth	narrow	broad
3. Peraeopod 5, segment 6, post. mar. spines	present (1 - 3 gps)	lacking
4. Mandible, right lacinia	multi-cusped	bifid
5. Coxa 4, hind margin	straight	convex
6. Gnathopods 1 & 2 propod form	slender (L > 2X D)	deep (L < 2X D)
7. Peraeopods 3 & 4 seg. 5 dist. spines	short	long
8. Peraeopod 5, basis no. apical spines	wide	narrow
9. Peraeopod 5, segment 4	narrow (L > W)	broad (W > L)
10. Peraeopod 6, seg. 4, shape	smoothly sloped	sub-rectangular
11. Peraeopod 7 hind cusps	weak (5)	strong (8)
12. Uropod 1, displaced spine	lacking	present
13. Uropod 2, outer ramus spines	many (6+)	few (1 - 3)
14. Uropod 3 (female) ramal form	aequiramal	inaequiramal
15. Telson lobes, gps. dorso-lat. spines	1 - 2	0
16. Antenna 2, ped. 4 no. spine groups	1	2 - 3

TABLE VII. Species of *Foxiphalus:* Characters, Character States, and Plesio-Apomorphic (P.-A.) Codings

	CHARACTER STATES	
CHARACTERS	**Plesiomorphic** (=0)	**Apomorphic** (=2)
1. Epistomal cusp	lacking	strong
2. Eye size (female)	large	small
3. Antenna 2, ped. 4, no. facial spines	many (10)	few (3 - 8)
4. Coxa 4, hind margin	straight	convex
5. Mandible, right lacinia	bifid	monocuspate
6. Mandible, left lacinia	4-dentate	few-dent
7. Mxpd. i.p. spines	2	1
8. MX1, palp, apci. sps.	2	0 - 1
9. Gnathopods 1 & 2, form of propod	expanding distally	margins sub-parallel
10. Gnathopods 1 & 2, form of carpus	elongate lobe wide	short, lobe narrow
11. Peraeopod 5, segments 4 & 5, width	narrow (L > W)	broad (W > L)
12. Peraeopod 6, segment 4, width	narrow (L > W)	broad (W > L)
13. Uropod 2, number of ramal spines	numerous (3 - 5)	few (0 - 2)
14. Pleon 3, marg. setose	few	many
15. Uropod 1, extent of ramal spines	proximal & distal	proximal only
16. Uropod 1, displ. sp.	absent	present
17. Uropod 3, term seg.	large	small
18. U3 (fem.) ram. marg.	setose	spinose
19. Telson, apic. spines	2 - 3	1
20. Telson, d.-l. spines	present	0 (or setae)

TABLE VIII. Species of *Rhepoxynius*: Characters, character states, and plesio-apomorphic (P.-A.) codings

	CHARACTER STATES	
CHARACTERS	**Plesiomorphic** (=0)	**Apomorphic** (=2)
1. UL, epistome	rounded	produced
2. Rostrum, excavate	deeply	shallowly
3. Antenna 2, ped. 4, no. spine groups	1 - 2	0
4. Mandible, no. of molar spines	many (5+)	few (< 5)
5. Mxpd. no. outer plate spines	many (10+)	few (< 10)
6. Maxilla 1, palp length	long	short
7. Gnathopod 2, shape of propod	linear (shallow)	expanded (deep)
8. Peraeopods 3 & 4, seg. 6. no. distal spines	many (10+)	few (< 10)
9. Peraeopod 5, width of segment 4	narrow (W < L)	broad (W > L)
10. Peraeopod 5, width of segment 5	narrow (W < L)	broad (W > L)
11. Peraeopod 6, seg. 4	narrow	broad
12. Peraeopod 7, basis no. hind serrations	many (6+)	few (2 - 3)
13. Pleon side plate 3	square	rounded
14. Urop. 1, ram. spines	many (5+)	few (0 - 1)
15. Uropod 1, size of displaced spine	large	lacking
16. Uropods 1 & 2, rhombic spines	lacking	present
17. Uropod 2, ped. spines	many	few
18. Urop. 3 (fem), rami	aequiramal	inaequiramal
19. Telson lobes, apices	spinose	setose

TABLE IX. Genera of Metharpiniinae: Character States and Plesio-Apomorphic (P.-A.) Codings

GENUS		CHARACTER STATES																			P.-A. INDEX
SYM	NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
A	GRANDIFOXUS	0	1	0	0	0	0	1	0	1	1-	1+	0	0	1	1	1+	0	1	0+	9
B	BERINGIAPHOX	2	2	0+	0	0	0+	1-	0	1	1-	1	0	2	1	2	0	0	1+	0	14
C	MAJOXIPHALUS	2	0	0	0	0	0+	0	0	0+	1	2	0	2	0	2	0	0	0	2	11
D	FOXIPHALUS	2	2	2	1	1	1+	2	2	1	2	2	1	0+	0+	0+	1+	2	2	2	29
E	RHEPOXYNIUS	0	2	2	1+	1	1-	2-	2	2-	0+	1	1	1+	0+	1	1+	2-	2	2	24
F	MICROPHOXUS	0	0	1?	0+	2	2	1-	2	0	1-	1	1	2	2	0	2	2	1+	0	20
G	METHARPINIA	0	0	1?	0+	1+	2-	0	1	1	2	1	1	2	1	0	0	0	1+	0	14

TABLE IX. Genera of Metharpiniinae: Character States and Plesio-Apomorphic (P.-A.) Codings

TABLE X. Species of *Grandifoxus*: Character States and Plesio- Apomorphic (P.-A.) Codings

SPECIES		CHARACTER STATES																P.-A. INDEX
SYM	NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
A	grandis	0	0	0	0	0	0	2	2	2	2	2	0	2	0	0	0	12
B	lindbergi	1	2	2	1+	0	1	0	1	2	1+	0	0	1	2	0	0+	14+
C	longirostris	2	2	2	2	1	1	1?	1-	1	0	1-	2	2	1+	1	2-	12+
D	constantinus	2	2	2	1	1	1	1	1-	1	0	1	1	2-	2	1	2	21
E	dixonensis	2	2	2	2	1+	1	1+	1-	1	0	1	1	2-	2?	1	2	22
F	robustus	0+	2	2	?	?	1+	2-	1-	1	1+	1+	?	?	1+	1	0+	16?
G	westi	2	2	2	?	?	?	1	1	0	1+	0	0?	?	2-	1?	0+	16?
H	vulpinus	2-	1	1	1	1	2	1-	0	1	0	0+	1	2	2	1	2-	18
J	acanthinus	2-	1	2	1+	0+	1	1	0+	1	0	1	1+	1	2	1	2	17
K	aciculatus	2-	2	1	?	0	1	1+	0+	1	0	1	2	1+	2	1	2-	18
L	nasutus	2	2	2	2	1+	1	2-	0	0+	0	1	1	2	0+	2	2	20
M	pseudonasutus	2	2	2	2	2	1	2	0	0+	0	1	1	1	0+	2	2	20

TABLE X. Species of Grandifoxus: Character States and Plesio- Apomorphic (P.-A.) Codings

TABLE XI. Species of *Foxiphalus*: Character States and Plesio- Apomorphic (P.-A.) Codings

SPECIES		CHARACTER STATES																				P.-A.
SYM	NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	INDEX
A	obtusidens	0	1	1	1+	0	0	2	2	1+	2	0+	1	0	0	0	0+	1	0+	0+	0	16+
B	cognatus	1	1	2	2	2	0	2	1	1	1	1	1	0	0	0	1+	1	1	0+	0	20+
C	xiximeus	0	0	2	0	2	0	2	1	1	1	2	2	2	2	2	2	0	1	2	0	24
D	aleuti	0	0	0	0+	0	0	0	2	1	1	0	1+	2	1	2	2	1+	2	1-	2	18
E	similis	2	1	2	1	2	1	2	0	2	2	0	0	1	1	0	2	1	2	0-	2	24
F	slatteryi	2	1	2	2	2	1	2	0	2	2	0	0	1	1	0	2	0+	2	1-	2	25
G	golfensis	0+	2	2	2	0	0	2	1	2	2	0	1	0?	0	0	2+	1-	0+	0	1	17
H	falciformis	0	2	1+	2	0	0?	2	1	2	2	0	1	2	1	0	0+	1+	2	0	2	20
J	fucaximeus	0	0	2	0+	2	0	2	1	1	1	2	2	2	2	2	2	0	1-	1	0	23

TABLE XI. Species of *Foxiphalus*: Character States and Plesio- Apomorphic (P.-A.) Codings

TABLE XII. Species of *Rhepoxynius*: Character States and Plesio- Apomorphic (P.-A) Codings

SPECIES		CHARACTER STATES																			P.-A. INDEX /38
SYM	NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
A	abronius	2	0	0	1	1-	2-	0+	0+	2	1+	1	0	0	0	2	0	0	0	0	12
B	lucubrans	1	1+	0+	0	1?	0	1-	2	2	1+	1	0	0+	1-	0	0	0+	0	0	11
C	tridentatus	0	2-	1+	2	1-	0	1	1	1	2	2-	1+	2-	1	2	1	1	2	1	24
D	pallidus	0	2-	0+	1+	1	1+	1-	0-	2-	2	2-	1+	1-	0+	2	1	1	2	0+	20
E	stenodes	0	1	1+	2	1?	0+	2-	1-	1+	1	1+	1	0+	1	2	2	1-	1	1+	20
F	homocuspidatus	2	2	1+	2-	2-	1+	0+	0+	1+	1+	2	1-	1	2	2	2	2	0+	1+	24
G	heterocuspidatus	0	2	1	2-	1	0+	0	1-	0+	1	1-	0+	0	2	2	2	2	0	1+	18+
H	gemmatus	2	2	1	1	1+	0+	0	1	1	1	1	0+	1+	2	0	2	1	0	1	18+
J	menziesi	2	0+	0	0	1	0+	1-	0	2	1	1	0	0	1	0	0	1-	0	0+	10
K	vigitegus	2	0+	1+	1+	1	2-	0+	0	2	2	1	0+	2	2	2	0	1+	2	1+	23
L	bicuspidatus	2-	2	2	2-	1+	1	0-	1+	1	1	1	2	2	1	2	0	1	2	1	25
M	boreovariatus	2-	1	1+	2	0	1+	0+	0+	0+	1	0+	1	2	2	2	0	2	2	1+	20+
N	variatus	2	2-	1	2	0	1	0+	0+	0+	0+	0	1	2-	2	2	0	1+	2	2-	22
O	barnardi	1+	1	2	2-	1+	1	1+	0	0	0	1	2	2	2	2	0	2	2	2-	24
P	daboius	1	1	2	2	1	1	1-	0	2-	2-	1+	1+	1+	2	2	0	2	2	2-	26
Q	fatigans	1	0+	2	2	1+	1+	0+	0	2-	2-	1+	1+	2	2	2	0	1	2	2	23

TABLE XII. Species of *Rhepoxynius*: Character States and Plesio-Apomorphic (P.-A) Codings